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A PILOT STUDY OF HUMAN FACTORS IN SAR.(U)
MAY 82 D I REMONDINI, M LIGHT, M L EVERSON
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This report is the eleventh in a series which documents the Probability of Detection in Search and Rescue Project at the USCG R&D Center.

16. Abstract

During three visual detection experiments, the USCG R&D Center collected human factors information. Various human factor parameters thought intuitively to affect the performance of a lookout were measured and analyzed. These included experience level, time on watch, amount of sleep, and lookout position. In addition, Hidden Pattern and Figure Tests were administered to the lookout subjects in these studies.

This report presents the results of this pilot study. Lookout subjects from HH-3F and HH-52A helicopters, 82-ft patrol boats (WPBs), 210-ft medium endurance cutters (WMECs), and 41-ft small utility boats (UTBs) were included.

Time on watch was found to have a marked influence on performance of lookouts on surface units. A marginal relationship was found between test scores and performance. Data from an experiment dedicated to human factors parameters is necessary for a proper investigation.

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METRIC CONVERSION FACTORS

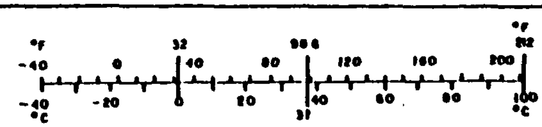
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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The authors would like to express their appreciation to the numerous Coast Guard rescue units and personnel that participated in the experiments described in this report.

A special thank you is extended to Ms. Denise Baird and Mr. Carl Buehler who were instrumental in the data and software preparation.

EXECUTIVE SUMMARY

INTRODUCTION

1. Purpose of Report

This report presents the human factors results of three visual detection experiments conducted by the Coast Guard Research and Development Center. The following human factors were analyzed: experience level, time on watch, amount of sleep, lookout position. In an attempt to identify qualities for good lookouts, the Hidden Pattern Test and Hidden Figure Test of the Educational Testing Services were administered.

2. Background

The visual detection experiments were performed in the spring and fall of 1980 in Block Island Sound, and in the winter of 1981 in the Gulf of Mexico off of Panama City, Florida. The experiments were designed for the determination of sweepwidths and probability of detection for various combinations of search units, weather and targets (Reference 1). The collection of data for human factors in visual search was secondary; therefore the usefulness of the data is limited. Data collected on the parameters of relative bearing and lateral range of target, target type, wind speed, sighting range, and cloud cover were analyzed elsewhere (Reference 2).

In the experiments, searches were conducted mostly in the same manner as actual missions. Search targets, consisting of 16-ft open boats, life rafts, 41-ft utility boats (UTBs), and simulated persons in the water (PIWs), were anchored in the search area, while the tracklines of the search units (SRU) were monitored and recorded using a microwave tracking system. Each SRU had at least one observer aboard to record sighting and human factors information. Valid sightings of targets were determined by a comparison of the sighting reports maintained by observers aboard the SRUs to the scaled reconstruction of the actual search track. A valid detection was recorded as a "hit". The maximum lateral range of detection for each SRU type on the day in question was determined. Any target, whose lateral range was less than or equal to 1.5 times the maximum lateral range of detection, and was not recorded as a sighting, was determined to be a "miss". Templates depicting the field of view of the various lookouts were used with the scaled reconstructions to determine which lookouts should be charged with missing a valid target sighting (Appendix H).

The data were analyzed using a non-parametric statistical method, contingency table for independent samples (Reference 3). This method determines whether two subjects (e.g., hours on watch and detection of target) are independent, but does not determine the nature of the relationship between dependent subjects.

CONCLUSIONS

Human Factors parameters thought to affect lookout performance were analyzed with the following results.

* Hidden Figures and Hidden Pattern tests measuring one's ability to distinguish obscure figures and patterns were administered. A positive, but marginal relationship between higher test scores and higher detection frequency exists.

* The relationship of lookout position and detection frequency shows the bridge crew on cutters performing worse than port and starboard side primary lookouts.

* The relationship of lookout experience and detection frequency shows that persons with less experience had a higher detection frequency for cutters while those with more experience had a higher detection frequency for UTBs and helos.

* The relationship of a lookout's hours on watch and detection frequency shows a reduction in detection frequency as time on watch increased for cutters and UTBs. For helos, hours on watch and detection frequency were independent.

* For all SRU types, detection frequency was independent of the lookout's prior sleep.

RECOMMENDATIONS

1. Since there appeared to be a positive, albeit marginal, relationship between higher written test scores and higher detection frequency, it would seem useful to explore the possibility that these tests or others may be used to identify individuals who would function more efficiently as lookouts.

2. While the analysis made did not provide evidence of a distinction between the frequencies of detection by different SRUs, there would intuitively seem to be differences in efficiency of detection under given conditions. This would possibly be revealed in a different type of analysis (References 1 and 2).

3. The rather curious findings in regard to experience vs. SRU type may be the result of unknown or at least unmeasured parameters. Especially interesting are the consistently lower values for the intermediate levels of experience (1-3 years). One may attribute these findings to some complex of motivation or career pattern influences. This seems important enough for further study.

4. Time on watch has a marked influence on a lookout's performance on surface SRUs. This should be used to modify the procedures employed for assignment of lookouts.

5. Future studies should be dedicated to the collection of human factors data. Such tests would allow direct comparisons to make between SRUs, target

types, and individual lookouts. These future tests should be structured to gather the appropriate needed data. If real progress is to be made in understanding and ultimately modeling the human factors that influence the SAR problem, experiments dedicated to these ends must be undertaken.

6. Training for effective lookout procedures may have to wait until the human factors that affect it are more sharply defined.

7. Significant difference is found in detection performance of the bridge crew versus side lookouts for cutters. While it is unreasonable to expect the Quartermaster of the Watch to do better than dedicated lookouts, some relocation of the 82-ft patrol boat bridge instrumentation could increase the performance of the helmsman. When using LORAN for steering, the helmsman must face aft. Simply placing a LORAN repeater in front of the helmsman would not only provide another set of eyes for searching, but also make it much easier for the helmsman to stay on track.

Introduction:

This report presents results of three visual detection experiments conducted by the Coast Guard Research and Development Center. The experiments were performed in the spring and fall of 1980 in Block Island Sound, while those of the winter of 1981 were done in the Gulf of Mexico off Panama City, Florida. These experiments, involving human factors in Search and Rescue (SAR) operations, were secondary to those involved in gathering other information related to the probability of visual detection of various targets (Reference 1). Thus, some limitations existed on the conduct of these experiments. They are to be regarded as pilot studies from which recommendations can be made for future work.

Various human factor parameters thought intuitively to affect the performance of a lookout were measured and analyzed. These include the amount of experience as a lookout, the elapsed time on watch at the time of sighting, the physical position of the lookout on the search and rescue unit (SRU), and the amount of sleep prior to the start of the experiment. In addition, two written tests were administered to all lookouts. These were th Hidden Patterns Test and the Hidden Figures Test (Educational Testing rvices). Finally, other data were collected and included the visual aid ted, e.g. sunglasses, relative bearing and lateral range of the target, get type, wind speed, visibility, sighting range, and cloud cover. No a ot was made to analyze these latter parameters because of their heterogene d because at least some of them are analyzed elsewhere (Reference 2).

Methods:

These human factor experiments were conducted as addendums to the visual studies described in Reference 1. These human factor experiments used the following classes of SRU's - HH-3F and HH-52A helicopters, 82-ft patrol boats (WPBs) and 210-ft WMEC cutters, and 41-ft utility boats (UTBs). The target types included 16-ft open boats, orange life rafts with and without orange canopies, black rafts, 41-ft UTB boats, and simulated persons in the water (PIW).

The visual search area was controlled and defined depending on environmental conditions. In order to make maximum use of resources and because aircraft with their higher search speeds required a much lower target density, surface craft and aircraft were scheduled on different days. On surface craft days, two cutters and two boats conducted searches; on aircraft days a maximum of two helicopters (HH-3F or HH-52A) and two fixed-wing aircraft (HC-130 or HU-16E) conducted searches, although not enough human factor data was collected on the latter two types of SRU to analyze.

Targets were positioned at predetermined locations by the monitoring vessels. Each day, a microwave tracking system (MTS) was utilized to accurately determine the initial location of anchored targets. Additionally, at the end of each search day, target locations were again checked to ensure that the targets had remained stationary. On some occasions the end-of-day checks indicated that targets had drifted from their initial positions. These targets were then eliminated from the data base since their positions during the search could not be determined to the required accuracy (within 0.1 nm).

The number and positions of the targets relative to planned search tracks were designed to provide about six detection opportunities per hour. This number was a compromise between the desire to obtain as much data as possible in a given interval and not biasing the results of the experiment by overloading the lookouts.

Throughout each experiment the MTS was used to locate the position of SRUs and targets. A master transmitter unit was used in conjuction with up to two secondary units to obtain fixes on the position of each SRU as it searched. The OSC's (on-scene commander's) monitoring vessel was also tracked so that when targets were set, their positions could be marked. Each search unit was equipped with a mobile transponder to re-transmit signals received from the master transmitter. The operation of the MTS is described in detail in References 1 and 2.

When possible, searches were conducted in the same manner as actual SAR missions. Twenty-four hours prior to each search, the Coast Guard R&D Center released a SAR exercise (SAREX) message to each SRU, providing it with the detailed information necessary to prepare for and conduct the desired visual searches. Each morning, targets were towed to the search area and positioned by the monitoring vessel which also served as a command post for the OSC. After the targets were positioned, the SRUs proceeded to designated start positions and initiated search procedures as described in the SAREX message.

Each SRU had at least one observer on board. It was the observer's task to record sighting information, ensure that the search plan was being followed, note any artificial influences which might bias the test results, gather human factors information, and record any suggestions for improving the experiment. The observer also recorded all pertinent data for each target sighting such as the time of day, estimated target range, estimated relative bearing of the target. These were the prime parameters used to decide whether a sighting was a valid detection. Information about each lookout was gathered which included hours of sleep prior to the SAREX, years of experience in SAR, and hours on watch during the exercise.

On each day of the experiment, up to four SRUs searched simultaneously and provided a number of replications for each set of environmental conditions encountered. Boats and cutters searched simultaneously on each search day designated for surface craft. Both helicopters and fixed-wing aircraft searched simultaneously on each search day for aircraft. This procedure was intended to provide data for a direct comparison of different type search units under the same environmental conditions. All units were provided with the same information and similar search instructions to eliminate bias in favor of any particular SRU type. Controllable factors such as search speed and search pattern were randomized in order to minimize bias due to unknown or unmeasurable factors. For example, to minimize the chance that any changes in performance attributed to a change in search speed might be due to uncontrollable or unknown factors, each SRU was assigned a high speed for one search and a low speed for the other. The order in which these speeds were assigned was alternated between successive units. Additionally, search patterns were almost always changed between consecutive searches. Thus, a variety of search speeds for each pattern was obtained. Helicopter and boat crews were generally changed on successive days while the crews for cutters changed weekly. The human study data base includes information on individuals.

Valid sightings of SAR targets were determined by comparison of the sighting reports maintained by observers on board SRUs to the scaled reconstruction of the actual search track. Reconstruction provided SRU tracks annotated with time and target positions. For each sighting, the time of the sighting and the estimated range and relative bearing were compared to actual target positions. If a sighting was determined to be a valid detection, it was recorded as a "hit". The lateral range and values of the other conditions were also recorded. The maximum lateral range of detection for each particular SRU type on the day in question was determined. That value was then multiplied by 1.5. Any target, whose lateral range was less than or equal to 1.5 times the maximum lateral range of detection, and was not recorded as a sighting, was determined to be a "miss". Thus, a separate raw data file was developed for each search unit on a particular day that included all valid hits and all misses that met the criterion above. The use of the 1.5 multiplier is to compensate for the assumption that any particular sighting was not likely to be at the absolute maximum distance at which a sighting was possible under the conditions present at that time.

Templates depicting the field of view of the various lookouts were used with the scaled reconstructions to determine which lookout should be charged with missing a valid target sighting (Appendix H). In this manner, hits and misses with their ancillary information were recorded. Checking and confirmation followed. Thus, a data file was made for each day's activities for each SRU. Where appropriate to do so, data files were combined for certain analyses.

Because of the level of measurement and the type of data collected, much of it must be analyzed using non-parametric statistics. Tests of this nature are useful when one wishes to avoid making assumptions about the level of measurement employed, about the sampling distribution, and other assumptions about the model being used. In general, the fewer the assumptions made, the more general are the conclusions. However, the more powerful statistical tests are those with the strongest assumptions. This can be partially conpensated by choosing appropriate tests and getting larger samples.

The method chosen was the contingency table for independent samples (Reference 3). In this test the hypothesis is that rows and columns are independent, i.e. the probability that an individual measurement will occur in any particular row is unaffected by the particular column to which it belongs. To test the hypothesis, one calculates the expected frequency for each cell using the proportional relationships that exist between both marginal totals and the expected cell frequency. After each cell's expected frequency is calculated, the procedure is then to calculate the chi square value (X^2), and to determine the probability associated with that value by using the standard chi square table.

$$X^2 = \sum_{i=1}^{i=r} \sum_{j=1}^{j=k} \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

where

O_{ij} = observed number of cases in the ith row and the jth column

E_{ij} = expected number of cases in the ith row and the jth column

$$\sum_{i=1}^{i=r} \sum_{j=1}^{j=k}$$ directs one to sum over all rows (r) and all columns (k) i.e. over all cells

The expected value, E_{ij}, for each cell is calculated by multiplying the two marginal totals common to a particular cell and then dividing that product by the total number of cases. The degrees of freedom (d.f.) are calculated as d.f. = (rows - 1) (columns - 1).

The interpretation of the results of this test is based on the following rationale. If the difference between the observed frequencies and the expected frequencies (shown in parentheses in the tables) are quite small then the X^2 value is also small and this means that the null hypothesis, H_0, cannot be rejected. The H_0 is that the sets of characteristics are independent of one another. Alternatively, if the differences between the observed and expected frequencies are large, then the X^2 is also large. This is interpreted to mean that the groups differ with respect to these characteristics.

Finally, there are certain limitations when using this test. When the number of columns is larger than one and therefore d.f. is > 1, no more than 20% of the cells may have an expected frequency less than 5. Furthermore, no cell may have an expected frequency less than one.

Results:

The activity of searching for an object is a complex process involving physical and psychological factors. Clearly the rigorous measurement of these parameters would require greater knowledge than is presently available. Nevertheless, in this pilot study it was hoped that some relationship may be discovered between the empirical test results of detecting targets under actual field conditions, the ability to detect hidden patterns and figures in a written examination, and certain other human parameters.

The results of the written examination are presented in Table 1. It is known that the ability to distinguish obscure figures and patterns varies markedly among individuals. Various psychological bases for this are discussed in Reference 4. There may be some correlation between success on the tests and general intelligence level. Surely skill and experience in taking tests are significant factors. Differences observed in Table 1 are likely to be due to several of these factors.

The relationship between each test and the number of detections is depicted in Tables 2 and 3. The rather low probabilities in each are not significantly different from one another. The probabilities are too high to allow the rejection of the null hypothesis that target detection and test scores are independent of one another, i.e. there is some dependence between scores and hits. This dependency is somewhat stronger in the Hidden Figure Test.

TABLE 1: TEST SCORES STATISTICS

HIDDEN FIGURE TEST	MEAN	S.D.	RANGE	PERCENTILE 25 th	50 th	75 th	99 th	MAX. POSSIBLE SCORE	TOTAL N
UTRS	13.7 + 1.4	7.6	0 - 27	5.0	10.0	17.0	26.0	32	31
HELOS	18.5 ± 1.7	10.0	1 - 32	10.0	19.5	26.0	32.0	32	34
CUTTERS	12.4 ± 0.9	8.2	0 - 32	5.0	12.0	16.0	31.0	32	83
TOTAL	13.7 ± 0.7	8.9	0 - 32	5.5	12.0	20.5	32.0	32	148

HIDDEN PATTERN TEST	MEAN	S.D.	RANGE	PERCENTILE 25 th	50 th	75 th	99 th	MAX. POSSIBLE SCORE	TOTAL N
UTRS	71.4 + 6.4	31.2	16 - 120	53.0	82.0	88.0	107.0	200	23
HELOS	103.7 ± 4.3	25.0	55 - 171	87.0	102.0	107.0	161.0	200	34
CUTTERS	79.9 ± 2.6	23.9	18 - 141	64.0	81.0	92.0	131.0	200	82
TOTAL	84.3 ± 2.4	27.8	16 - 171	67.0	86.0	102.0	150.0	200	139

TABLE 2: DETECTION OF ALL TARGETS BY ALL SRUs vs. HIDDEN FIGURE TEST

PERCENTILES

	0 - 25	26 - 50	51 - 75	76 - 100	Total
HITS	82 (73.7)	80 (87.3)	92 (81.9)	104 (115.2)	358
MISSES	312 (320.3)	387 (379.7)	346 (356.1)	512 (500.8)	1557
TOTAL	394	467	438	616	1915

CHI SQUARED VALUE = 4.78
DEGREES OF FREEDOM = 3
PROBABILITY = $.1 < P < .2$
(Expected Value)

TABLE 3: DETECTION OF ALL TARGETS BY ALL SRUs vs. HIDDEN PATTERN TEST

PERCENTILES

	0 - 25	26 - 50	51 - 75	76 - 100	Total
HITS	90 (77.7)	78 (86.6)	85 (92.3)	93 (89.4)	346
MISSES	320 (332.3)	379 (370.4)	402 (394.7)	379 (382.6)	1480
TOTAL	410	457	487	472	1826

CHI SQUARED VALUE = 4.34
DEGREES OF FREEDOM = 3
PROBABILITY = $.2 < P < .3$
(Expected Value)

The highly significant probability associated with the X^2 value in Table 4 shows that the two tests are quite similar in what they measure. This is not unexpected since a person scoring high or low on one test would be expected to make a similar score on the other due to the similarity of what the tests purport to measure.

TABLE 4: HIDDEN FIGURE TEST vs. HIDDEN PATTERN TEST

HIDDEN FIGURE TEST

PERCENTILE

	0 - 25	26 - 50	51 - 75	76 - 100	Total
0 - 25	19 (8.4)	8 (8.4)	7 (7.9)	0 (9.2)	34
26 - 50	9 (8.7)	14 (8.7)	9 (8.2)	3 (9.5)	35
51 - 75	3 (8.9)	8 (8.9)	10 (7.4)	15 (9.7)	36
76 - 100	3 (7.9)	4 (7.9)	6 (7.5)	19 (8.6)	32
TOTAL	34	34	32	37	137

CHI SQUARED VALUE = 55.22
DEGREES OF FREEDOM = 9
PROBABILITY = $P < .001$
(Expected Value)

A natural question is to wonder how the three types of SRUs compared in their detection frequencies. Table 5 presents this data and tests the hypothesis that the number of hits or misses is independent of SRU type. The probability associated with that X^2 value is too high to allow the rejection of the hypothesis, yet is low enough to indicate that there is considerable variation between SRUs. This type of statistical test makes the fewest assumptions but has an unknown power to distinguish subtle differences. The data depicted in this table is pooled from all target types, weather conditions, search, protocols, and target ranges. Clearly the relative efficiency of SRU types is not being tested by this analysis. Nevertheless, at least under these experimental conditions the SRUs did not differ significantly from one another.

TABLE 5: DETECTION OF TARGETS BY SRU TYPE

	CUTTERS	UTBs	HELOS	TOTAL
HITS	244 (240.8)	91 (81.2)	107 (120.1)	442
MISSES	1186 (1189.2)	391 (400.8)	606 (592.9)	2183
TOTAL	1430	482	713	2625

CHI SQUARED VALUE = 3.19
DEGREES OF FREEDOM = 2
PROBABILITY = $0.2 < P < 0.3$
(Expected Value)

One way that the three types of SRUs differ is the performance of different lookout positions. Tables 6 A, B, and C test for independence of position and detection. A significant difference is found for cutters, with the bridge crew performing much worse than the side lookouts. No difference is found for helos and UTB's.

TABLE 6: POSITION vs. DETECTION

(A) CUTTERS

	PORT LOOKOUT	STARBOARD LOOKOUT	BRIDGE/HELM	TOTAL
HITS	99 (69.3)	90 (69.1)	55 (105.6)	244
MISSES	307 (336.7)	315 (335.9)	564 (513.4)	1186
TOTAL	1430	482	713	2625

CHI SQUARED VALUE = 52.25
DEGREES OF FREEDOM = 2
PROBABILITY = $P < 0.001$
(Expected Value)

(B) UTB's

	PORT LOOKOUT	STARBOARD LOOKOUT	BRIDGE/HELM	TOTAL
HITS	34 (33.7)	30 (30.9)	26 (25.4)	90
MISSES	146 (146.3)	135 (134.1)	110 (110.6)	391
TOTAL	180	165	136	481

CHI SQUARED VALUE = 0.05
DEGREES OF FREEDOM = 2
PROBABILITY = $0.95 < P < 0.98$
(Expected Value)

TABLE 6: POSITION vs. DETECTION

(C) HELOS

	PORT LOOKOUT	STARBOARD LOOKOUT	BRIDGE/HELM	TOTAL
HITS	10 (14.0)	26 (27.1)	71 (66.0)	107
MISSES	83 (79.0)	154 (152.9)	368 (373.0)	605
TOTAL	93	180	439	712

CHI SQUARED VALUE = 1.83
DEGREES OF FREEDOM = 2
PROBABILITY = $0.3 < P < 0.5$
(Expected Value)

One way that the three types of SRUs differ is the performance of different lookout positions. Tables 6 A, B, and C test for independence of position and detection. A significant difference is found for cutters, with the bridge crew performing much worse than the side lookouts. No difference is found for helos and UTB's.

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TOTAL	1430	482	713	2625

CHI SQUARED VALUE = 52.25
DEGREES OF FREEDOM = 2
PROBABILITY = $P < 0.001$
(Expected Value)

(B) UTB's

	PORT LOOKOUT	STARBOARD LOOKOUT	BRIDGE/HELM	TOTAL
HITS	34 (33.7)	30 (30.9)	26 (25.4)	90
MISSES	146 (146.3)	135 (134.1)	110 (110.6)	391
TOTAL	180	165	136	481

CHI SQUARED VALUE = 0.05
DEGREES OF FREEDOM = 2
PROBABILITY = $0.95 < P < 0.98$
(Expected Value)

TABLE 6: POSITION vs. DETECTION

(C) HELOS

	PORT LOOKOUT	STARBOARD LOOKOUT	BRIDGE/HELM	TOTAL
HITS	10 (14.0)	26 (27.1)	71 (66.0)	107
MISSES	83 (79.0)	154 (152.9)	368 (373.0)	605
TOTAL	93	180	439	712

CHI SQUARED VALUE = 1.83
DEGREES OF FREEDOM = 2
PROBABILITY = $0.3 < P < 0.5$
(Expected Value)

Tables 7 A, B, and C test for independence of SAR experience and detection of targets by SRU type. All have probabilities which allow the rejection of the null hypothesis of independence at the significant or highly significant level. A test for homogeneity (Table 7D) does not allow the three tables to be pooled. Thus, significant differences exist between SRU types with respect to experience in SAR. Interestingly, persons with less experience detected more targets than expected in cutters while those with greater experience detected more than expected in UTBs and helos. There was a curious lower level of detection than expected in all three SRU types in the 1-3 years category.

TABLE 7: EXPERIENCE vs. DETECTION

(A) CUTTERS

YEARS OF EXPERIENCE

	<.5	.5 - .9	1 - 3	>3	TOTAL
HITS	63 (47.1)	62 (53.2)	43 (56.5)	68 (79.2)	236
MISSES	217 (232.9)	254 (262.8)	293 (279.5)	403 (391.8)	1167
TOTAL	280	316	336	471	1403

CHI SQUARED VALUE = 14.02
DEGREES OF FREEDOM = 3
PROBABILITY = $.001 < P < 0.01$
(Expected Value)

(B) UTBs

YEARS OF EXPERIENCE

	<.5	.5 - .9	1 - 3	>3	TOTAL
HITS	7 (13.7)	22 (16.9)	30 (38.9)	19 (8.5)	78
MISSES	72 (65.3)	75 (80.1)	194 (185.1)	30 (40.5)	371
TOTAL	79	97	224	49	449

CHI SQUARED VALUE = 24.00
DEGREES OF FREEDOM = 3
PROBABILITY = $P < .001$
(Expected Value)

TABLE 7: EXPERIENCE vs. DETECTION

(C) HELOS

YEARS OF EXPERIENCE

	<.5	.5 - .9	1 - 3	>3	TOTAL
HITS	1 (2.7)	4 (1.1)	23 (31.8)	79 (71.4)	107
MISSES	17 (15.3)	3 (5.9)	189 (180.2)	397 (404.6)	606
TOTAL	18	7	212	476	713

CHI SQUARED VALUE = 14.82
DEGREES OF FREEDOM = 3
PROBABILITY = .001 < P < 0.01
(Expected Value)

TABLE 7D: TEST FOR HOMEGENEITY OF ALL SRUs EXPERIENCE vs. DETECTION

	HITS					MISSES							
	<.5	.5 - .9	1 - 3	>3	Total	<.5	.5 - .9	1 - 3	>3	Total	X^2	dF	P
CUTTERS	63	62	43	68	236	217	254	293	403	1167	14.02	3	<.001
UTBs	7	22	30	19	78	72	75	194	30	371	24.00	3	<.001
HELOS	1	4	23	79	107	17	3	189	397	606	14.82	3	.01 - .001
							(Sum of 3 CHI Square values)				52.84	9	
POOLED	71	88	96	166	421	306	332	676	730	1144	30.70	3	

	dF	X^2	P
Sum	9	52.84	<.001
Pooled	3	30.70	<.001
Homogeneity	6	22.14	.001 < P < .01

Tables 8 A, B, and C test the hypothesis of independence of detection and hours on watch. In Table 8A the probability associated with the X^2 value allows the rejection of H_0 for cutters. The data indicates a reduction in observed detection as time on watch increased with a considerably larger number of detections than expected during the first hour. Table 7B on UTBs shows a similar but weaker trend that yields a probability that is not significant indicating greater independence between time on watch and detection frequency. Table 8C for helos has a probability that indicates clearly an independence between time on watch and detection frequency. The time on task for helos was never greater than three hours in these experiments. Table 8D tests for homogeneity and reveals that it is not possible to pool the data from the three types of SRUs thus confirming that there are clear distinctions between the SRU types and time on watch with respect to detection frequency.

TABLE 8: HOURS on WATCH vs. DETECTION

(A) CUTTERS

	Hours on Watch					
	<1	1 - 1.9	2 - 2.9	3 - 3.9	>4	TOTAL
HITS	161 (130.0)	56 (71.8)	21 (26.8)	2 (9.4)	4 (6.0)	244
MISSES	601 (632.0)	365 (349.2)	136 (130.2)	53 (45.6)	31 (29.0)	1186
TOTAL	762	421	157	55	35	1430

CHI SQUARED VALUE = 22.41
DEGREES OF FREEDOM = 4
PROBABILITY = $P < .001$
(Expected Value)

(B) UTBs

	Hours on Watch					
	<1	1 - 1.9	2 - 2.9	3 - 3.9	>4	TOTAL
HITS	35 (29.5)	27 (22.1)	16 (17.6)	4 (8.9)	9 (13.0)	91
MISSES	121 (126.5)	90 (94.9)	77 (75.4)	43 (38.1)	60 (56.0)	391
TOTAL	156	117	93	47	69	482

CHI SQUARED VALUE = 7.64
DEGREES OF FREEDOM = 4
PROBABILITY = $.1 < P < .2$
(Expected Value)

(C) HELOS

	Hours on Watch			
	<1	1 - 1.9	2 - 2.9	TOTAL
HITS	63 (66.3)	34 (34.7)	10 (6.0)	107
MISSES	379 (375.7)	197 (196.9)	30 (34.0)	606
TOTAL	442	231	40	713

CHI SQUARED VALUE = 3.34
DEGREES OF FREEDOM = 2
PROBABILITY = $.20 > P > .10$
(Expected Value)

TABLE 8D: TEST FOR HOMOGENEITY OF ALL SRUs HOURS ON WATCH vs. DETECTION

	HITS						MISSES								
	<1	1 - 1.9	2 - 2.9	3 - 3.9	>4	TOTAL	<1	1 - 1.9	2 - 2.9	3 - 3.9	>4	TOTAL	X^2	dF	P
CUTTERS	161	56	21	2	4	244	601	365	136	53	31	1186	22.41	4	<.001
UTBs	35	27	16	4	9	91	121	90	77	43	60	391	7.64	4	.1 - .2
HELOS	63	34	10	0	0	107	379	197	30	0	0	606	3.34	2	.1 - .2
									(Sum of 3 CHI Square values)				33.39	10	
POOLED	259	117	47	6	13	442	1101	652	243	96	91	2183			

	dF	X^2	P
Sum	10	33.39	<.001
Pooled	4	14.72	.001 - .01
Homogeneity	6	18.67	.001 - .01

Tables 9 A, B, C, test for the independence of amount of sleep by lookouts prior to the SAREX and the detection frequency. It is clear that in all types of SRUs tested the amount of sleep seemed to be independent of the detection frequency. In an attempt to achieve greater strength in rejecting the null hypothesis, a test for the validity of pooling the data on all SRUs was made in Table 9D. It is permissible to pool but the probability remains non significant at the 5 percent rejection level. Table 10 shows these calculations.

Table 9: PRIOR SLEEP vs DETECTION

(A) CUTTERS

	Hours of Sleep			
	<4	4 - 6	>6	TOTAL
HITS	20 (25.1)	47 (42.0)	120 (119.9)	187
MISSES	134 (128.9)	211 (216.0)	606 (617.1)	962
TOTAL	154	258	737	1149

CHI SQUARED VALUE = 1.94
DEGREES OF FREEDOM = 2
PROBABILITY = $.3 < P < .5$
(Expected Value)

(B) UTBs

	Hours of Sleep			
	<4	4 - 6	>6	TOTAL
HITS	1 (3.8)	25 (25.7)	65 (61.5)	91
MISSES	19 (16.2)	111 (110.3)	261 (264.5)	391
TOTAL	20	136	326	482

CHI SQUARED VALUE = 2.78
DEGREES OF FREEDOM = 2
PROBABILITY = $.2 < P < .3$
(Expected Value)

(C) HELOS

	Hours of Sleep			
	<4	4 - 6	>6	TOTAL
HITS	1 (1.2)	14 (15.8)	92 (90.0)	107
MISSES	7 (6.8)	91 (89.2)	508 (510.0)	606
TOTAL	8	105	600	713

CHI SQUARED VALUE = 0.32
DEGREES OF FREEDOM = 2
PROBABILITY = $.8 < P < .9$
(Expected Value)

TABLE 9D: TEST FOR HOMOGENEITY OF ALL SRUs PRIOR SLEEP vs DETECTION of TARGETS

	HITS				MISSES						
	≤ 4	4 - 6	≥ 6	TOTAL	≤ 4	4 - 6	≥ 6	TOTAL	X^2	dF	P
CUTTERS	20	47	120	187	134	211	617	962	1.94	2	.3 - .5
UTBs	1	25	65	91	19	111	261	391	2.78	2	.2 - .3
HELOS	1	14	92	107	7	91	508	606	0.32	2	.8 - .9
						(Sum of 3 CHI Square values)			5.04	9	
POOLED	22	86	277	385	160	413	1386	1959	2.80	2	

	dF	X^2	P
Sum	6	5.04	.5 - .7
Pooled	2	2.80	.05 - .10
Homogeneity	4	2.24	.5 - .7

Table 10: DETECTION OF ALL TARGETS BY ALL SRUs vs SLEEP

	HOURS OF SLEEP			
	<4	4 - 6	>6	TOTAL
HITS	22 (29.9)	86 (82.0)	277 (273.1)	385
MISSES	160 (152.1)	413 (417.0)	1386 (1389.9)	1959
TOTAL	182	499	1663	2344

CHI SQUARED VALUE = 2.82
DEGREES OF FREEDOM = 2
PROBABILITY = $.2 < P < .3$
(Expected Value)

Summary

This report presents Human Factors data gathered during the SAR POD visual detection experiments. Human Factors parameters thought to affect lookout performance were analyzed with the following results.

* Hidden Figures and Hidden Pattern tests measuring one's ability to distinguish obscure figures and patterns were administered. A positive, but marginal relationship between higher test scores and higher detection frequency exists.

* The relationship of lookout position and detection frequency shows the bridge crew on cutters performing worse than port and starboard side primary lookouts.

* The relationship of lookout experience and detection frequency shows that persons with less experience had a higher detection frequency for cutters while those with more experience had a higher detection frequency for UTBs and helos.

* The relationship of a lookout's hours on watch and detection frequency shows a reduction in detection frequency as time on watch increased for cutters and UTBs. For helos, hours on watch and detection frequency were independent.

* For all SRU types, detection frequency was independent of the lookout's prior sleep.

Recommendations:

1. Since there appeared to be a positive, albeit marginal, relationship between higher written test scores and higher detection frequency, it would seem useful to explore the possibility that these tests or others may be used to identify individuals who would function more efficiently as lookouts.

2. While the analysis made did not provide evidence of a distinction between the frequencies of detection by different SRUs, there would intuitively seem to be differences in efficiency of detection under given conditions. This would possibly be revealed in a different type of analysis (Reference 1 and 2).

3. The rather curious findings in regard to experience vs. SRU type may be the result of unknown or at least unmeasured parameters. Especially interesting are the consistently lower values for the intermediate levels of experience (1-3 years). One may attribute these findings to some complex of motivation or career pattern influences. This seems important enough for further study.

4. Time on watch has a marked influence on a lookout's performance on surface SRUs. This should be used to modify the procedures employed for assignment of lookouts.

5. Future studies should be dedicated to the collection of human factors data. Such tests would allow direct comparisons to make between SRUs, target types, and individual lookouts. These future tests should be structured to gather the appropriate needed data. If real progress is to be made in understanding and ultimately modeling the human factors that influence the SAR problem, experiments dedicated to these ends must be undertaken.

6. Training for effective lookout procedures may have to wait until the human factors that affect it are more sharply defined.

7. Significant difference is found in detection performance of the bridge crew versus side lookouts for cutters. While it is unreasonable to expect the Quartermaster on Watch to do better than dedicated lookouts, some relocation of the 82-ft WPB bridge instrumentation could increase the performance of the helmsman. When using LORAN for steering, the helmsman must face aft. Simply placing a LORAN repeater in front of the helmsman would not only provide another set of eyes for searching, but also make it much easier for the helmsman to stay on track.

References:

1. Edwards, Jr., N.C., Osmer, S.R., Mazour, T.J., and Hover, G.L. 1981. Factors Affecting Coast Guard SAR Unit Visual Detection Performance. Interim Report CG-D-09-82, U.S. Department of Transportation, U.S. Coast Guard Office of Research and Development, Washington, D.C. 20593

2. Edwards, Jr., N.C., Osmer, S.R., Mazour, T.J. and Hover, G.L. 1980. Analysis of Visual Detection Performance for 16-foot Boat and Life Raft Targets. Interim Report CG-D-24-80, U.S. Department of Transportation, U.S. Coast Guard Office of Research and Development, Washington, D.C. 20593.

3. Woolf, Charles M. 1968. Principles of Biometry. D. Van Nostrand Co., Inc. Princeton, New Jersey.

4. Bucklin, Bruce, L. 1971. Field Dependence and Visual Detection Ability. Technical Report 4137, U.S. Army Research and Development Center, Picatinny Arsenal, Dover, New Jersey 07801.

APPENDIX A

THIS IS AN EXAMPLE OF A DATA FILE. IT CONTAINS SAR HUMAN FACTORS DATA FOR A GIVEN SRU (CUTTER, HELO, UTB) FOR THAT DAY. THERE ARE 51 COLUMNS OF DATA WHICH ARE EXPLAINED ON THE FOLLOWING PAGES. COLUMNS 2-6 (NAME) HAVE BEEN DELETED FOR PRESENTATION IN THIS REPORT.

```
2 1        BMCM////////////////400130200032165120300510
3 1        SA  0020000001800150102120100072165120300710
4 1        MK2 0000011004800440301130450092175120201110
5 1        MKC 0130012005300460402112600172175120201710
6 0        SA  ////////////////108120800062175120399910
7 0        SN  0060009004900410102112700202175120399910
8 0        SA  ////////////////111123500043175120399910
9 1        SA  ////////////////112120300043175120300510
10 1        SA  ////////////////114120100062175120301510
11 1        SA  ////////////////116120900102175120301010
12 1        SA  ////////////////117120100002175120301010
13 0        SN  ////////////////110112400222175120399910
14 1        SA  ////////////////119120100012175120302110
15 1        SN  ////////////////116113000122175120301310
16 0        MK2 ////////////////301120850112165120299910
17 0        BMCM////////////////411130850112165120399910
18 1        MK2 ////////////////302120300012165120201010
19 0        SS2 0010005003600280104112800153165120/99910
20 0        MK2 ////////////////306120850232165120299910
21 1        SS2 ////////////////10511300009316512O/00910
22 1        SS2 ////////////////10711340010316512O/01410
23 0        SN  ////////////////103113500043175120399910
24 0        BMCM////////////////411033500043175120399910
25 0        BMCM////////////////426032800153165120399910
```

APPENDIX A

FIELD DEFINITIONS OF DATA BASE

Columns	Item	Code or Entry Method	Explanation
1	Hit or Miss	Hit = 1 Miss = 0	Hit - Lookout detected target Miss - Lookout did not detect target
2-7	Name	First six letters of last name	
8-11	Rating/Rank	LT, BM3, etc	Lookout's rank or rating
12-27	Test Scores	Add leading zero to all scores 100, i.e., 50.4 entered 0504	Four tests: Two hidden figure tests Two hidden pattern tests
28	Experience	Yrs / Code .5 / 1 .5 - .9 / 2 1 - 3 / 3 >3 / 4	Years of experience on SRU type
29-30	Hrs on watch	Add leading zero to all values <1.0, i.e., .4 entered 04; 2.5 entered 25	Elapsed time on watch at time of sighting
31	Visual aid	Yes = 1 No = 0	Were visual aids used, i.e., binoculars
32	Lookout	SRU / Posit / Code UTB / Port / 1 Ctr / Side Helo / Port Scanner 1	Position of lookout in SRU

APPENDIX A (Cont.)

FIELD DEFINITIONS OF DATA BASE

Columns	Item	Code or Entry Method	Explanation
		UTB Stbd Ctr Side 2 Helo Stbd Scanner 2 UTB Helm QMOW Ctr OOD 3 Helo Pilot 3 Copilot	
33-35	Relative Bearing	Three Digits i.e. 075	For Hits - Relative Bearing at which target was sighted For Misses - Last relative bearing in lookouts zone of responsibility (see SRU templates in appendix)

Columns	Item	Code or Entry Method	Explanation
36-38	Lateral Range	Add one leading zero to all values <10 and two zeros to all values <1 i.e. 6.3 entered 063 .7 entered 007	Distance in nautical miles from SRU to target when target is abeam SRU

APPENDIX A (Cont.)

FIELD DEFINITIONS OF DATA BASE

Columns	Item	Code or Entry Method	Code	Explanation
39	Target Type	Type	Code	
		16' White Boat Orange Canopy Raft	1	
		16' Blue Boat Orange Raft	2	
		Black Raft	3	
		41' UTB	4	
		PIW (Person in water) (used mannequins)	5	
40-42	Wind Speed	Add leading zero to value 10 i.e. 9.0 entered 090 12.0 entered 120		Wind speed in knots
43-45	Visibility	Add leading zero to values 10		Meteorological visibility in nautical miles
46	Sleep	Hrs. 4 — Code 1 4-6 — 2 6 — 3		Hours of sleep lookout had in last 24 hours
47-49	Sighting Range	Add one leading zero to all values 10 and two leading to all values 1		Distance in Nautical Miles For Hits - Range at which target was sighted For Misses - Range of target at last opportunity for sighting in lookout's zone of responsibility (see templates in Appendix H)

APPENDIX A (Cont.)

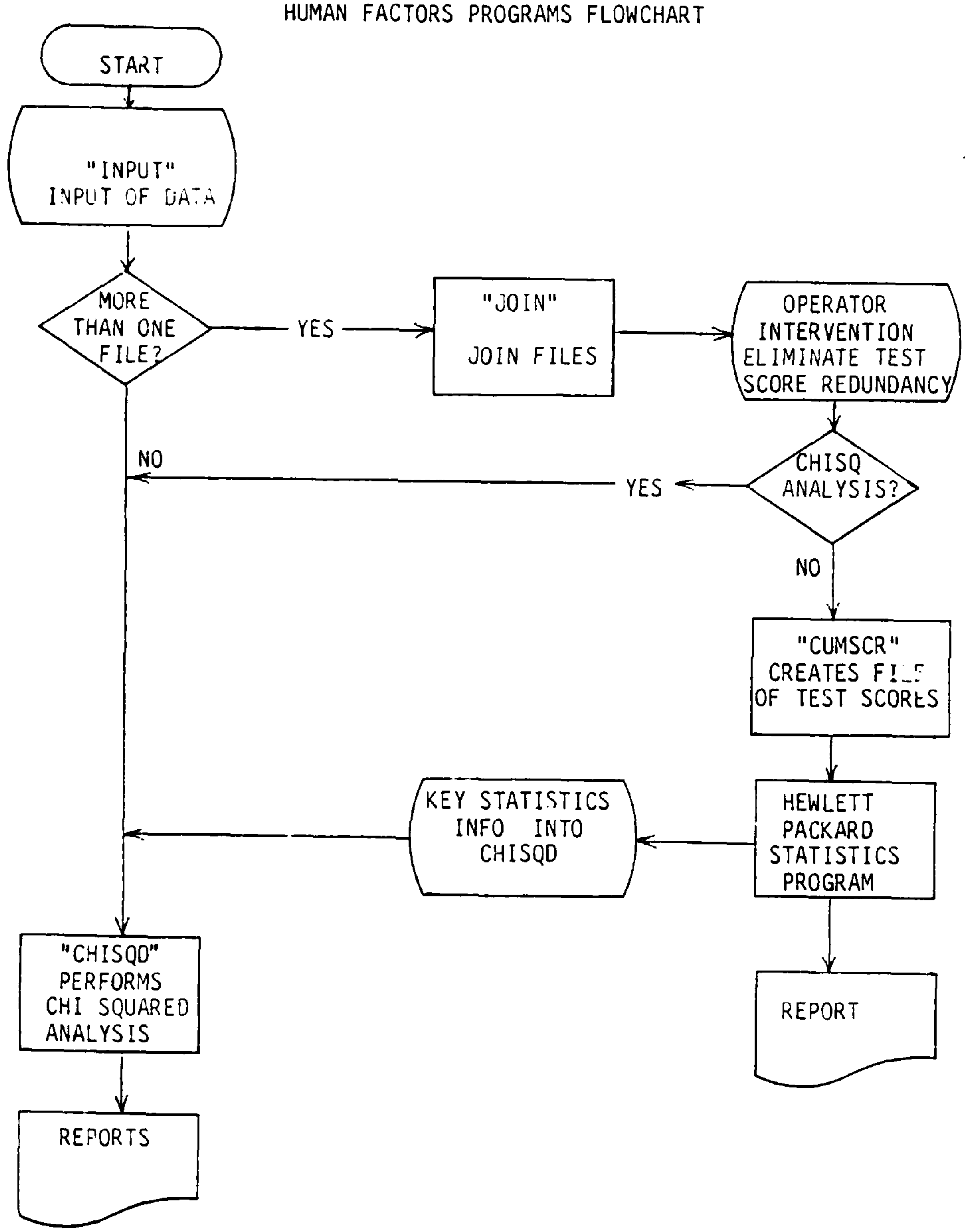
FIELD DEFINITIONS OF DATA BASE

Columns	Item	Code or Entry Method	Explanation
50-51	Cloud Cover	Add leading zero to values <10 i.e. 5 entered 05 10 entered 10	Tenths of sky covered by clouds
51	SRU Type	Type / Code: Cutter 1 UTB 2 Helo 3	

Missing Data for any item is denoted by a slant bar (/). An individual's test scores are listed only once per file. Thereafter slant bars are entered in those columns.

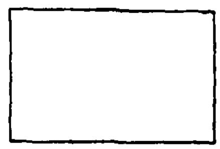
APPENDIX B

HUMAN FACTORS PROGRAMS FLOWCHART

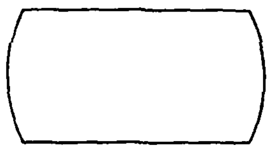


APPENDIX B

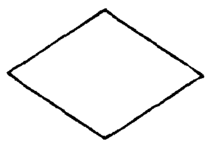
FLOWCHART LEGEND



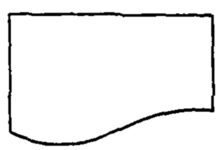
COMPUTER PROGRAMS



KEYING OPERATIONS



DECISIONS



DOCUMENTS

APPENDIX C

"INPUT" PROGRAM

This program builds a file on Human Factors in SAR from the keyboard using symbols defined offline. The output is a file which represents the data for one SRU for one day.

```
10 ! THIS PROGRAM IS CALLED "INPUT"
20 ! THIS PROGRAM BUILDS A FILE OF DATA ON HUMAN FACTORS IN SAR FROM
30 ! THE KEYBOARD USING SYMBOLS DEFINED OFFLINE.
40 ! THE OUTPUT IS A FILE WHICH REPRESENTS THE DATA FOR ONE SRU FOR ONE DAY.
50   DIM O$(300)[52]
60   DIM Iline$[52]
70   DIM E$[52]
80 ! Fname$="    "
90   PRINTER IS 16
100   PRINT PAGE
110   PRINT LIN(14)
120  INPUT "DO YOU WANT TO CORRECT OR ADD TO AN EXISTING FILE?(C OR A)",Re$
130  IF (Re$="C") OR (Re$="A") THEN GOTO 170
140  IF Re$="N" THEN GOTO 230
150  PRINT "PLEASE RESPOND WITH A 'C'FOR CORRECT OR AN 'A' FOR ADDITION."
160  GOTO 100
170  PRINT PAGE
180  PRINT LIN(14)
190  EDIT "ENTER THE  NAME OF THE FILE THAT YOU WANT TO MODIFY.",Fname$
200   Fname$=Fname$&":T14"
210   IF (Re$="C") OR (Re$="A") THEN GOTO 580
220  ASSIGN #1 TO Fname$
230    EDIT "- DATE OF SEARCH= ",Date$
240    INPUT "NEW FILENAME ????",Fname$
250    INPUT "HOW MANY RECORDS IN THE FILE????",Rn
260    CREATE Fname$&":T14",Rn,60
270    IF LEN(Date$)=7 THEN GOTO 360
280    PRINTER IS 16
290    PRINT PAGE
300    PRINT LIN(14)
310    BEEP
320    BEEP
330    BEEP
340    PRINT "INCORRECT DATA INPUT.  PLEASE CORRECT IT."
350    GOTO 230
360    EDIT "- SEARCH UNITS NAME (10 CHRS MAX)= ",Uname$
370    IF (LEN(Uname$)<11) AND (LEN(Uname$)>3) THEN GOTO 450
380    PRINT PAGE
390    PRINT LIN(14)
400    BEEP
410    BEEP
420    BEEP
430    PRINT "INCORRECT DATA INPUT.  PLEASE CORRECT IT."
440    GOTO 360
450    EDIT "- SEARCH UNIT TYPE (1=Cutter, 2=Helo, 3=Boat)= ",Utype$
460    IF (Utype$="1") OR (Utype$="2") OR (Utype$="3") THEN GOTO 540
470    PRINT PAGE
480    PRINT LIN(14)
490    BEEP
500    BEEP
510    BEEP
520    PRINT "INCORRECT DATA INPUT.  PLEASE CORRECT IT."
530    GOTO 450
540    Rn=1
550    PRINTER IS 16
560    PRINT PAGE
570    PRINT LIN(14)
580    PRINT "---------------------------------------------------------"
590    PRINT
600    PRINT "YOU MAY NOW:"
610    PRINT
620    PRINT "- ENTER A NEW DATA LINE."
630    PRINT
640    PRINT "- ENTER 'C' TO CORRECT A LINE."
650    PRINT "(REMEMBER TO PRESS 'STOP' WHEN YOU'RE FINISHED"
660    PRINT
```

```
670    PRINT "- ENTER 'F' TO END THE DATA INPUT,"
680    PRINT
690    PRINT "-ENTER 'R' TO RESTART A DATA FILE."
700    PRINT
710    PRINT "BOY ARE YOU EVER LUCKY,MARK!!!!!!"
720    EDIT "*===============================================**",Iline$
730    Hom$=Iline$[1,1]
740    IF Hom$="F" THEN GOTO 2070
750    IF Hom$="C" THEN GOTO 910
760    IF Hom$="R" THEN GOTO 1110
770    IF Hom$<>"L" THEN GOTO 1180
780    INPUT "ENTER THE OPPORTUNITY NUMBER OF THE LINE YOU WANT LISTED.",Ln
790 !  IF Ln<Rn THEN GOTO 820
800 !  PRINT PAGE
810 !  PRINT LIN(14)
820 !  PRINT "THE LINE YOU HAVE SPECIFIED HAS NOT BEEN ENTERED YET."
830 !  GOTO 760
840 !  PRINT PAGE
850 !  PRINT "LINE #";Ln;"="
860 !  PRINT "*===============================================**"
870   ! PRINT O$(Ln+1)
880 !  Iline$=""
890   ! PRINT LIN(2)
900   ! GOTO 540
910    PRINT PAGE
920    PRINT LIN(14)
930    Srn=Rn
940    PRINT "HIT STOP WHEN FINISHED CORRECTING !!!"
950    INPUT "ENTER THE # OF THE LINE TO BE CORRECTED.",Rn
960 !  IF Srn>Rn THEN GOTO 950
970 !  PRINT "THE LINE YOU HAVE SPECIFIED HAS NOT BEEN ENTERED YET."
980 !  GOTO 910
990    PRINT PAGE
1000   PRINT LIN(14)
1010   PRINT "MAKE CORRECTIONS THEN HIT 'CONT'."
1020   ASSIGN #1 TO Fname$
1030   Rn=Rn+1
1040   READ #1,Rn;O$(Rn)
1050   PRINT O$(Rn)
1060   EDIT O$(Rn)
1070 ! PRINT O$(Rn)
1080 ! PAUSE
1090   PRINT #1,Rn;O$(Rn)
1100   GOTO 940
1110   PRINT PAGE
1120   PRINT LIN(14)
1130   INPUT "ENTER NEXT LINE TO BE INPUTED",Rs
1140   ASSIGN #1 TO Fname$
1150   READ #1,Rs
1160   Rn=Rs
1170   GOTO 580
1180   IF (Hom$="1") OR (Hom$="0") THEN E$=" "
1190   IF (Hom$<>"1") AND (Hom$<>"0") THEN E$="E"
1200   E$=E$&"        "
1210   E$=E$&"     "
1220   IF Iline$[12,15]="    " THEN GOTO 1250
1230   T1=VAL(Iline$[12,15])
1240   GOTO 1260
1250   T1=50
1260   IF (T1<=1000) AND (T1>=0) THEN E$=E$&"     "
1270   IF (T1>1000) OR (T1<0) THEN E$=E$&"EEEE"
1280   IF Iline$[16,19]="    " THEN GOTO 1310
1290   T2=VAL(Iline$[16,19])
1300   GOTO 1320
1310   T2=50
1320   IF (T2<=1000) AND (T2>=0) THEN E$=E$&"     "
```

```
1330    IF (T2>1000) OR (T2<0) THEN E$=E$&"EEEE"
1340    IF Iline$[20,23]="////" THEN GOTO 1370
1350    T3=VAL(Iline$[20,23])
1360    GOTO 1380
1370    T3=50
1380    IF (T3<=1000) AND (T3>=0) THEN E$=E$&"    "
1390    IF (T3>1000) OR (T3<0) THEN E$=E$&"EEEE"
1400    IF Iline$[24,27]="////" THEN GOTO 1430
1410    T4=VAL(Iline$[24,27])
1420    GOTO 1440
1430    T4=50
1440    IF (T4<=1000) AND (T4>=0) THEN E$=E$&"    "
1450    IF (T4>1000) OR (T4<0) THEN E$=E$&"EEEE"
1460    IF Iline$[28,28]="/" THEN GOTO 1490
1470    Exp=VAL(Iline$[28,28])
1480    GOTO 1500
1490    Exp=1
1500    IF (Exp=1) OR (Exp=2) OR (Exp=3) OR (Exp=4) THEN E$=E$&" "
1510    IF (Exp<>1) AND (Exp<>2) AND (Exp<>3) AND (Exp<>4) THEN E$=E$&"E"
1520    How=VAL(Iline$[29,30])
1530    IF (How<=70) AND (How>=0) THEN E$=E$&"  "
1540    IF (How>70) OR (How<0) THEN E$=E$&"EE"
1550    IF (Iline$[31,31]="1") OR (Iline$[31,31]="0") THEN E$=E$&" "
1560    IF (Iline$[31,31]<>"1") AND (Iline$[31,31]<>"0") THEN E$=E$&"E"
1570    Pos=VAL(Iline$[32,32])
1580    IF (Pos=1) OR (Pos=2) OR (Pos=3) THEN E$=E$&" "
1590    IF (Pos<>1) AND (Pos<>2) AND (Pos<>3) THEN E$=E$&"E"
1600    Rb=VAL(Iline$[33,35])
1610    IF (Rb<=360) AND (Rb>=0) THEN E$=E$&"   "
1620    IF (Rb>360) OR (Rb<0) THEN E$=E$&"EEE"
1630    Lr=VAL(Iline$[36,38])
1640    IF (Lr<=250) AND (Lr>=0) THEN E$=E$&"   "
1650    IF (Lr>250) OR (Lr<0) THEN E$=E$&"EEE"
1660    Type=VAL(Iline$[39,39])
1670    IF (Type<6) AND (Type>0) THEN E$=E$&" "
1680    IF (Type>5) OR (Type<1) THEN E$=E$&"E"
1690    Wind=VAL(Iline$[40,42])
1700    IF (Wind<=250) AND (Wind>=0) THEN E$=E$&"   "
1710    IF (Wind>250) OR (Wind<0) THEN E$=E$&"EEE"
1720    Vis=VAL(Iline$[43,45])
1730    IF (Vis<=250) AND (Vis>=0) THEN E$=E$&"   "
1740    IF (Vis>250) OR (Vis<0) THEN E$=E$&"EEE"
1750    IF Iline$[46,46]="/" THEN GOTO 1780
1760    Sleep=VAL(Iline$[46,46])
1770    GOTO 1790
1780    Sleep=1
1790    IF (Sleep=1) OR (Sleep=2) OR (Sleep=3) THEN E$=E$&" "
1800    IF (Sleep<>1) AND (Sleep<>2) AND (Sleep<>3) THEN E$=E$&"E"
1810    Sr=VAL(Iline$[47,49])
1820    IF (Sr<=250) AND (Sr>=0) THEN E$=E$&"   "
1830    IF (Sr<>999) AND (Sr>250) OR (Sr<0) THEN E$=E$&"EEE"
1840    IF Sr=999 THEN E$=E$&"   "  ! 999 DENOTES ABSENCE OF DATA. D.B.7/16/81
1850    Cc=VAL(Iline$[50,51])
1860    IF (Cc<=10) AND (Cc>=0) THEN E$=E$&"  "
1870    IF (Cc>10) OR (Cc<0) THEN E$=E$&"EE"
1880    IF LEN(Iline$)<>51 THEN E$=RPT$("L",LEN(Iline$))
1890    IF E$=RPT$(" ",51) THEN GOTO 2010
1900    PRINT PAGE
1910    PRINT LIN(12)
1920    PRINT "INCORRECT DATA INPUT.  PLEASE CORRECT THE INDICATED MISTAKES."
1930    PRINT
1940    PRINT "**************************************************"
1950    PRINT Iline$
1960    PRINT E$
1970    BEEP
1980    BEEP
```

```
1990   BEEP
2000   GOTO 720
2010   Rn=Rn+1
2020   O$(Rn)=Iline$
2030   Iline$=""
2040   IF Srn>0 THEN Rn=Srn
2050   Srn=0
2060   GOTO 550
2070   IF (Re$="C") OR (Re$="A") THEN GOTO 2300
2080   PRINTER IS 0
2090   PRINT LIN(5)
2100   PRINT Date$,Uname$,"TYPE= ";Utype$,"OPTS= ";Rn-1
2110   PRINT
2120   PRINT "FILENAME= ";Fname$[1,4]
2130   ASSIGN #1 TO Fname$&":T14"
2140   PRINT #1,1;Fname$,Date$,Uname$,Utype$,VAL$(Rn)
2150   FOR X=2 TO Rn
2160   PRINT #1,X;O$(X)
2170   PRINT "**************************************************"
2180   PRINT O$(X),X-1
2190   NEXT X
2200   PRINT "**************************************************"
2210   PRINT "END OF LISTING"
2220   PRINT LIN(5)
2230   ASSIGN * TO #1
2240   PRINTER IS 16
2250   PRINT PAGE
2260   PRINT LIN(14)
2270   PRINT "FILE NAME - ",Fname$[1,4]
2280   PRINT "END OF LISTING"
2290   GOTO 2380
2300   PRINTER IS 0
2310   FOR X=Rs TO Rn
2320   PRINT #1,X;O$(X)
2330   PRINT "**************************************************"
2340   PRINT O$(X),X-1
2350   NEXT X
2360   PRINT "**************************************************"
2370   PRINT "END OF LISTING"
2380   END
```

APPENDIX D

"JOIN" PROGRAM

This program joins a number of raw data files (from "INPUT" program) together and stores the resulting file in a new tape file.

```
10    !                   JOIN
20    !   THIS PROGRAM JOINS A NUMBER OF RAW DATA FILES TOGETHER AND STORES
30    !          THE RESULTING FILE IN A NEW TAPE FILE.
40    !   THIS PROGRAM WAS ORIGINALLY THE "APPEND" PROGRAM ,WRITTEN
50    !   BY DON CUNDY. IT WAS MODIFIED BY D. BAIRD FOR USE IN POD/SAR
60    !   ON THE HUMAN FACTORS DATA.     8/4/81.....D.BAIRD
70    !   BEFORE RUNNING THIS PROGRAM THE OPERATOR MUST TYPE IN FOLLOWING-
80    !   CREATE "file :T14",___,60  THEN EXECUTE
90    !   ASSIGN #1 TO "file :T14"  THEN EXECUTE
100   !   PRINT #1,1;2  THEN EXECUTE
110   !   AFTER YOU HAVE THE "JOIN" PROGRAM IN MEMORY PLACE THE DATA FILES
120   !   TAPE IN T15 AND THE NEW TAPE IN T14.  THIS IS DONE BEFORE TYPING
130   !   IN THE ABOVE CREATE,ASSIGN, AND PRINT STATEMENTS.
140   !
150   !
160   DIM B$(500)[52]
170   PRINTER IS 0
180   INPUT "ENTER THE NEW FILE NAME",New$
190   INPUT "ENTER FILE NAME TO BE COMBINED",File$
200   ASSIGN #1 TO File$
210   ASSIGN #2 TO New$&":T14"
220   BUFFER #2
230   READ #2,1;J
240  I=2
250   ON END #1 GOTO 320
260   READ #1,I;B$(I)
270   PRINT #2,J;B$(I)
280   PRINT I;J;B$(I)
290   I=I+1
300   J=J+1
310   GOTO 260
320   PRINT #2,1;J
330   REWIND
340   END
```

APPENDIX E

"CUMSCR" PROGRAM

This program accumulates the Hidden Figures and Hidden Patterns test scores in an array suitable for analysis by the Basic Statistics and Data Manipulation programs.

```
10 !   THIS PROGRAM IS CALLED "CUMSCR" BECAUSE IT ACCUMULATES THE TEST
20 !   SCORES IN AN ARRAY SUITABLE FOR ANALYSIS BY THE BASIC STATISTICS
30 !   AND DATA MANIPULATION PROGRAMS.  IT USES THE OUTPUT FROM "JOIN".
40 !   IT MUST BE MODIFIED FROM THE KEYBOARD SO THAT A SCORE APPEARS
50 !   ONCE AND ONLY ONCE FOR EACH INDIVIDUAL.
60     OPTION BASE 1
70     DIM R$(600)[52],Test$[40],Name$[40],Ts1(40),Ts2(40),Test1(40),Test2(40),Te
st1$[8],Test2$[8]
80          INPUT "INPUT DATAFILE NAME ????",Join$
90        CREATE "TEST3",50,8
100       CREATE "TEST4",50,8
110    ASSIGN #1 TO Join$&":T14"
120     ASSIGN #2 TO "TEST3"
130    ASSIGN #3 TO "TEST4"
140    I=1
150    J=1
160    K=1
170    M1=0
180    M2=0
190     I=I+1
192      ON END #1 GOTO 440
200     READ #1,I;R$(I)
210    Name$=R$(I)[2,11]
220    Test$=R$(I)[12,27]
230    IF Test$="////////////////" THEN GOTO 190
240       Test1$=R$(I)[12,19]
250       Test2$=R$(I)[20,27]
260       IF Test1$<>"////////" THEN GOTO 290
270       M1=M1+1
280       GOTO 340
290    T1=VAL(R$(I)[12,15])
300    T2=VAL(R$(I)[16,19])
310    PRINT Name$,T1,T2
320    Ts1(J)=(T1+T2)/10
330    J=J+1
340    IF Test2$<>"////////" THEN GOTO 370
350    M2=M2+1
360    GOTO 190
370    T3=VAL(R$(I)[20,23])
380    T4=VAL(R$(I)[24,27])
390    PRINT Name$,T3,T4
400    Ts2(K)=(T3+T4)/10
410    K=K+1
430    GOTO 190
440    !
450    MAT Test1=Ts1
460    MAT Test2=Ts2
470    MAT PRINT #2;Test1,END
480    MAT PRINT Test1;
490    PRINT "NUMBER OF SCORES MISSING IN FIELD 1=";M1
491    PRINT
492    PRINT
493    PRINT
500    MAT PRINT #3;Test2,END
510    MAT PRINT Test2;
520    PRINT "NUMBER OF SCORES MISSING IN FIELD 2=";M2
530    END
```

APPENDIX F

"CHISQD" PROGRAM

This program runs against either single files of joined files and does a Contingency Table Analysis.

```
10 ! THIS PROGRAM IS CALLED "CHISOD"
20 ! THIS IS DESIGNED TO RUN AGAINST EITHER SINGLE FILES OR JOINED FILES"
30 ! AND TO DO A CONTINGENCY TABLE ANALYSIS"
40 ! THIS PROGRAM WAS WRITTEN BY LTJG LOUIS NASH,USCG , IN 1982, FOR
50 ! HUMAN FACTOR PART/OF THE SAR POD PROJECT AT THE USCG R&D CENTER.
60 !
70 ! THIS VERSION IS FOR ALPHABETIC OR CODE ORDERED FILES ONLY.
80 !
90    OPTION BASE 1
100   OVERLAP
110   DIM R$(2700)[53],Rowcat(20),Colcat(20),Scrncat(20)
120   DIM O(10,10),E(10,10),A(10),B(10)
130   DIM Or(10,10),Orrowcat(20),Orcolcat(20)
140   COM Nsub,Labsub$(16)[40],Pos(4,16),S$,S1$
150   ASSIGN #2 TO "LABRAY:T15"        !CONTAINS THE NAMES OF THE SUBJECTS
160   ASSIGN #3 TO "POSITH:T15"         !CONTAINS THE POSITIONS OF DIFFERENT
170 !                                   SUBJECTS IN THE DATA STRING
180 !
190   Nsub=16            ! Nsub IS THE NUMBER OF SUBJECTS WHOSE LABELS ARE
200                      !        CONTAINED IN Labsub$(Nsub) , AND STRING POSITIONS
210                      !        IN Pos(4,Nsub)
220                      ! ONLY Nsub AND THE DIMENSION STATEMENTS NEED TO BE
230                      ! CHANGED FOR THE PROGRAM TO HANDLE MORE SUBJECTS
240   FOR I=1 TO Nsub
250    READ #2;Labsub$(I)
260     NEXT I
270 !
280   FOR I=1 TO Nsub
290    READ #3;Pos(1,I),Pos(2,I),Pos(3,I),Pos(4,I)
300     NEXT I
310 !
320   GOSUB 3250
330 !
340   CALL Sublist
350 !
360   INPUT "ENTER CODE FOR SUBJECT FOR COLUMNS",Icol
370   IF (Icol<1) OR (Icol>Nsub) THEN 360
380   INPUT "ENTER CODE FOR SUBJECT FOR ROWS",Irow
390   IF (Irow<1) OR (Irow>Nsub) THEN 380
400   INPUT "DO YOU WISH TO SCREEN THE DATA?",S$
410   S1$=S$
420   IF S$<>"Y" THEN 470
430   INPUT "ENTER CODE FOR SUBJECT FOR SCREENING",Iscreen
440   IF (Iscreen<1) OR (Iscreen>Nsub) THEN 400
450 !
460   CALL Bound(2,Iscreen,L,Scrncat(*),Spos1,Spos2,Spos3,Spos4)
470   CALL Bound(1,Icol,M,Colcat(*),Cpos1,Cpos2,Cpos3,Cpos4)    !SET CATEGORIES
480   CALL Bound(0,Irow,N,Rowcat(*),Rpos1,Rpos2,Rpos3,Rpos4)
490 !
500   GOSUB 3440            !REVIEWS SUBJECTS AND CATEGORIES AND PROVIDES A
510 !                        CHANCE TO MAKE CORRECTIONS
520   Exval=0
530   D1=D2=0
540   Mval=0
550   Counter=0
560   PRINT PAGE
570   PRINT "THANKYOU, PLEASE STAND BY"
580 !
590 ! SORTS THE DATA INTO CATEGORIES
600 !
610   FOR Jrec=2 TO Rec
620    Jstep=Jrec
630     Skip=0
640 !
650      CALL Screen(R$(Jstep),Spos1,Spos2,Spos3,Spos4,L,Iscreen,Scrncat(*),S)
660 !
```

```
670      IF S=0 THEN Excluded
680       IF (Icol<>2) AND (Icol<>3) THEN 730     !IF NO TEST SCORES FOR COLUMN
690        CALL Combine(Ccode,Cpos1,Cpos2,Cpos3,Cpos4,R$(Jrec),D1)
700         IF D1=2 THEN GOTO Missing
710           GOTO 770
720 !
730        Colcode$=R$(Jstep)[Cpos1,Cpos2]    !START SORTING FOR NONE TEST SCORES
740         IF Colcode$[1,1]="/" THEN GOTO Missing
750          CALL Convert(Ccode,Colcode$,Icol)
760 !
770          CALL Sort(M,Ccode,Colcat(*),Jcol)   !SORT DATA INTO COLUMNS
780          IF Jcol>M THEN GOTO Excluded
790          IF Skip=1 THEN GOTO Repeat
800 !
810          IF (Irow<>2) AND (Irow<>3) THEN 860
820          CALL Combine(Rcode,Rpos1,Rpos2,Rpos3,Rpos4,R$(Jrec),D2)
830          IF D2=2 THEN GOTO Missing
840          GOTO 900
850 !
860       Rowcode$=R$(Jstep)[Rpos1,Rpos2] !START SORTING NON TEST SCORES FOR ROWS
870          IF Rowcode$[1,1]="/" THEN GOTO Missing
880          CALL Convert(Rcode,Rowcode$,Irow)
890 !
900          CALL Sort(N,Rcode,Rowcat(*),Jrow)
910          IF Jrow>N THEN GOTO Excluded
920          D=D1+D2+1
930          IF (D<>2) AND (S<>2) THEN Normal
940          IF (Icol<>1) AND (Irow<>1) THEN Normal
950 !
960 !
970 Repeat: IF (Irow=2) OR (Irow=3) THEN Skip=1
980      IF S=2 THEN 1010
990      CALL Screen(R$(Jstep),Spos1,Spos2,Spos3,Spos4,L,Iscreen,Scrncat(*),S)
1000     IF S=0 THEN Excluded
1010     O(Jrow,Jcol)=O(Jrow,Jcol)+1
1020 !
1030     Jstep=Jstep+1
1040     IF Jstep>Rec THEN 1260
1050     IF R$(Jstep)[2,11]<>R$(Jrec)[2,11] THEN 1260
1060 !
1070     IF D1=1 THEN 860
1080     IF D2=1 THEN 730
1090     IF S=2 THEN 680
1100     STOP
1110 !
1120 !
1130 Missing:Mval=Mval+1
1140  IF Skip=1 THEN GOTO 1030
1150  GOTO 1260
1160 !
1170 !
1180 Excluded:Exval=Exval+1
1190  IF Skip=1 THEN GOTO 1030
1200  GOTO 1260
1210 !
1220 !
1230 Normal:O(Jrow,Jcol)=O(Jrow,Jcol)+1
1240 !
1250 !
1260          NEXT Jrec
1270 !
1280  PRINT PAGE
1290  CALL Table(N,M,O(*),E(*),Chisq,Df,A(*),B(*),Total)
1300 !
1310 ! PRINT TABLE
1320 !
```

```
1330  PRINTER IS 0
1340 !
1350  PRINT "                                   DATA FROM ";File$
1360  PRINT USING "/"
1370  IF S$<>"Y" THEN 1400
1380 !
1390  CALL Listcat(Iscreen,L,Scrncat(*),2)
1400  CALL Listcat(Icol,M,Colcat(*),1)
1410  CALL Listcat(Irow,N,Rowcat(*),0)
1420 !
1430  M1=M-1
1440  IF M>5 THEN 1710
1450 !
1460  PRINT USING "#,16X,A";"1"
1470  FOR J=2 TO M
1480   PRINT USING "#,11X,D";J
1490    NEXT J
1500  PRINT USING "8X,5A,//";"TOTAL"
1510  FOR I=1 TO N
1520   PRINT USING "#,2D,3X";I
1530    FOR J=1 TO M
1540     PRINT USING "#,8X,4D";O(I,J)
1550      NEXT J
1560    PRINT USING "8X,4D,/";B(I)
1570     PRINT USING "#,12X,A,4D.D,A";"(",E(I,1),")"
1580      FOR J=2 TO M1
1590       PRINT USING "#,4X,A,4D.D,A";"(",E(I,J),")"
1600        NEXT J
1610      PRINT USING "4X,A,4D.D,A,//";"(",E(I,M),")"
1620       NEXT I
1630  PRINT USING "#,5A";"TOTAL"
1640  FOR J=1 TO M
1650   PRINT USING "#,9X,4D";A(J)
1660    NEXT J
1670  PRINT USING "8X,4D,/ ";Total
1680  GOTO 1960
1690 !
1700 !
1710  PRINT USING "#,9X,A";"1"
1720  FOR J=2 TO M
1730   PRINT USING "#,6X,2D";J
1740    NEXT J
1750  PRINT USING "4X,5A,/ ";"TOTAL"
1760  FOR I=1 TO N
1770   PRINT USING "#,2D";I
1780    FOR J=1 TO M
1790     PRINT USING "#4X,4D";O(I,J)
1800      NEXT J
1810    PRINT USING "4X,4D,/";B(I)
1820     PRINT USING "#5X,A,4D.D,A";"(",E(I,1),")"
1830      FOR J=2 TO M1
1840       PRINT USING "#,A,4D.D,A";"(",E(I,J),")"
1850        NEXT J
1860      PRINT USING "A,4D.D,A,  ";"(",E(I,M),")"
1870       NEXT I
1880  PRINT USING "#,5A";"TOTAL"
1890  PRINT USING "#,2X,4D";A(1)
1900  FOR J=2 TO M
1910   PRINT USING "#,3X,4D";A(J)
1920    NEXT J
1930  PRINT USING "3X,4D,  ";Total
1940 !
1950 !
1960  IMAGE 5X,19A,2X,DDDD.DDDD
1970  PRINT USING 1960;"CHI SQUARED VALUE =",Chisq
1980  PRINT "NUMBER OF MISSING VALUES = ";Mval
```

```
1990  PRINT "NUMBER OF EXCLUDED DATA = ";Exval
2000  PRINT "Degrees of Freedom = ";Df
2010  !
2020  PRINTER IS
2030  !
2040  INPUT "DO YOU WISH TO MODIFY THE TABLE ?",A$
2050  IF A$[1,1]<>"Y" THEN 3050
2060  IF Counter>0 THEN 2090
2070  CALL Aswitch(O(*),M,N,Rowcat(*),Colcat(*),Exval,Or(*),Ocol,Orow,Orrowcat(*
),Orcolcat(*),Nexval)
2080  Counter=1
2090  N1=N
2100  INPUT "DO YOU WISH TO COMBINE ANY ROWS ?",A$
2110  IF A$[1,1]<>"Y" THEN 2220
2120  INPUT "ENTER THE PAIR OF ADJACENT ROWS TO BE COMBINED",R1,R2
2130  CALL Switch(R1,R2)
2140  FOR J=1 TO M
2150   O(R1,J)=O(R1,J)+O(R2,J)
2160    O(R2,J)=0
2170     NEXT J
2180  Rowcat(2*R1)=Rowcat(2*R2)
2190  N1=N1-1
2200  INPUT "DO YOU WISH TO COMBINE ANY OTHER ROWS ?",A1$
2210  IF A1$[1,1]="Y" THEN 2120
2220  INPUT "DO YOU WISH TO ELIMINATE ANY ROWS ?",B$
2230  IF (B$[1,1]<>"Y") AND (A$[1,1]<>"Y") THEN 2570
2240  IF B$[1,1]<>"Y" THEN 2360
2250  INPUT "ENTER NUMBER OF ROW TO BE ELIMINATED.",R1
2260  FOR J=1 TO M
2270   Exval=Exval+O(R1,J)
2280    O(R1,J)=0
2290     NEXT J
2300  N1=N1-1
2310  INPUT "DO YOU WISH TO REMOVE ANOTHER ROW ?",B$
2320  IF B$[1,1]="Y" THEN 2250
2330  !
2340  !  CONSOLIDATE TABLE FOR CHANGES IN ROWS
2350  !
2360  MAT B=RSUM(O)
2370  !
2380  FOR I=1 TO N1
2390   I1=I
2400    IF B(I1)<>0 THEN 2450
2410     I1=I1+1
2420      IF I1<=N THEN 2400
2430       N1=I
2440       GOTO 2560
2450     IF I1=I THEN 2520
2460     FOR J=1 TO M
2470      O(I,J)=O(I1,J)
2480       O(I1,J)=0
2490        NEXT J
2500     B(I1)=0
2510     CALL Transfer(I,I1,Rowcat(*))
2520      NEXT I
2530  !
2540  !                 MAKE CHANGES IN COLUMNS
2550  !
2560  N=N1
2570  M1=M
2580  INPUT "DO YOU WISH TO COMBINE ANY COLUMNS ?",A$
2590  IF A$[1,1]<>"Y" THEN 2700
2600  INPUT "ENTER THE PAIR OF ADJACENT COLUMNS TO BE COMBINED",R1,R2
2610  CALL Switch(R1,R2)
2620  FOR I=1 TO N
2630  O(I,R1)=O(I,R1)+O(I,R2)
```

```
2640  O(I,R2)=0
2650  NEXT I
2660  Colcat(2*P1)=Colcat(2*P2)
2670  M1=M1-1
2680  INPUT "DO YOU WISH TO COMBINE ANY OTHER COLUMNS?",A1$
2690  IF A1$[1,1]="Y" THEN 2600
2700  INPUT "DO YOU WISH TO ELIMINATE ANY COLUMNS?",B$
2710  IF (B$[1,1]<>"Y") AND (A$[1,1]<>"Y") THEN 1290
2720  IF B$[1,1]<>"Y" THEN 2840
2730  INPUT "ENTER NUMBER OF COLUMN TO BE ELIMINATED",P1
2740  FOR I=1 TO N
2750   Exval=Exval+O(I,P1)
2760    O(I,R1)=0
2770     NEXT I
2780  M1=M1-1
2790  INPUT "DO YOU WISH TO REMOVE ANOTHER COLUMN?",B$
2800  IF B$[1,1]="Y" THEN 2730
2810 !
2820 !      CONSOLIDATE TABLE FOR CHANGES IN COLUMNS
2830 !
2840  MAT A=CSUM(O)
2850  FOR J=1 TO M1
2860  J1=J
2870  IF A(J1)<>0 THEN 2920
2880  J1=J1+1
2890  IF J1<=M THEN 2870
2900  M1=J
2910  GOTO 3000
2920  IF J1=J THEN 2990
2930  FOR I=1 TO N
2940  O(I,J)=O(I,J1)
2950  O(I,J1)=0
2960  NEXT I
2970  A(J1)=0
2980  CALL Transfer(J,J1,Colcat(*))
2990  NEXT J
3000  M=M1
3010  GOTO 1290
3020 !
3030 !          START NEW ANALYSIS
3040 !
3050  PRINT PAGE
3060  PRINT "YOU NOW HAVE SEVERAL CHOICES"
3070  PRINT "  CODE    CHOICE"
3080  PRINT "   1        END SESSION"
3090  PRINT "   2        CHANGE SUBJECTS AND CATEGORIES"
3100  PRINT "   3        ENTER NEW DATA AND/OR CHOICE 2"
3110  PRINT "   4        GET ORIGINAL TABLE BACK"
3120  INPUT "ENTER CODE FOR YOUR CHOICE",Ich
3130  PRINT PAGE
3140  IF (Ich<1) OR (Ich>4) THEN 3120
3150  Counter=0
3160  ON Ich GOTO 3540,3190,3180,3210
3170 !
3180  GOSUB 3250               ! ENTER NEW TAPE
3190  GOSUB 3430               ! REVIEW SUJECTS AND CATEGORIES
3200  GOTO 520
3210  CALL Aswitch(Or(*),Ocol,Orow,Orrowcat(*),Orcolcat(*),Nexval,O(*),M,N,Rowca
t(*),Colcat(*),Exval)
3220  PRINT "YOU NOW HAVE THE ORIGINAL TABLE BACK"
3230  GOTO 2040
3240 !
3250  PRINT PAGE          !READS DATA TAPE
3260  PRINT "INSERT DATA TAPE INTO T14"
3270  INPUT "HIT 'CONT' WHEN READY",I
3280  PRINT PAGE
```

```
3290  INPUT "ENTER DATA FILE'S NAME ???",File$
3300  ASSIGN #1 TO File$&":T14"
3310  ON END #1 GOTO 3360
3320  Rec=2
3330  READ #1,Rec;P$(Rec)
3340  Rec=Rec+1
3350  GOTO 3330
3360  Rec=Rec-1
3370  OFF END #1
3380  OVERLAP
3390  RETURN
3400 !
3410 !           CHANGE SUBJECTS AND CATEGORIES
3420 !
3430  INPUT "DO YOU WISH TO SCREEN THE DATA",S1$
3440  CALL Review(2,Iscreen,L,Scrncat(*),Spos1,Spos2,Spos3,Spos4)
3450  CALL Review(1,Icol,M,Colcat(*),Cpos1,Cpos2,Cpos3,Cpos4)
3460  CALL Review(0,Irow,N,Rowcat(*),Rpos1,Rpos2,Rpos3,Rpos4)
3470  MAT O=(0)              !  INITIALIZE ARRAY
3480  MAT E=(0)
3490  MAT B=(0)
3500  MAT A=(0)
3510  RETURN
3520 !
3530 PRINT "PLEASE CHECK DATA FOR CORRECT ENTRIES."    !BAD DATA
3540 END
3550 !
3560 ! CALCULATES CONTINGINCY TABLES"
3570 !
3580  SUB Table(N,M,O(*),E(*),Chisq,Df,A(*),B(*),Total)
3590  DIM C(10)
3600  FOR J=1 TO M
3610   A(J)=0
3620   FOR I=1 TO N
3630    A(J)=A(J)+O(I,J)
3640     NEXT I
3650    NEXT J
3660   Total=0
3670   FOR I=1 TO N
3680    B(I)=0
3690    FOR J=1 TO M
3700     B(I)=B(I)+O(I,J)
3710      NEXT J
3720     Total=Total+B(I)
3730      NEXT I
3740  IF Total<>0 THEN 3770
3750  PRINT "Total =0 , Chisquare not calculated"
3760  SUBEXIT
3770  FOR I=1 TO N
3780   C(I)=B(I)/Total
3790    NEXT I
3800  Chisq=0
3810  FOR J=1 TO M
3820   FOR I=1 TO N
3830    E(I,J)=A(J)*C(I)
3840     IF E(I,J)<>0 THEN 3870
3850      Chisq=Chisq+O(I,J)^2
3860       GOTO 3880
3870     Chisq=Chisq+(O(I,J)-E(I,J))^2/E(I,J)
3880      NEXT I
3890       NEXT J
3900  Df=(M-1)*(N-1)
3910  SUBEND
3920 !
3930 ! PICK BOUNDARIES FOR CATEGORIES AND INIALIZES DATA POSITIONS
3940 !
```

```
3950  SUB Bound(Ind,Isub,M,Bounds(*),Pos1,Pos2,Pos3,Pos4)
3960  COM Nsub,Labsub$(*),Pos(*)
3970  PRINT PAGE
3980  CALL Heading(Isub,Ind)
3990  Pos1=Pos(1,Isub)
4000  Pos2=Pos(2,Isub)
4010  Pos3=Pos(3,Isub)
4020  Pos4=Pos(4,Isub)
4030  INPUT "ENTER NUMBER OF CATEGORIES",M
4040  IF M<=10 THEN 4090
4050  PRINT "SORRY, BUT THIS PROGRAM CAN NOT HANDLE MORE THAN 10"
4060  PRINT "CATEGORIES UNTIL THE DIMENSION STATEMENTS ARE CHANGED."
4070  PRINT "UNTIL THEN "
4080  GOTO 4030
4090  PRINT "YOU HAVE CHOSEN TO HAVE ";M;" CATEGORIES, THEREFORE"
4100  PRINT "YOU MUST SET THE UPPER (UB) AND LOWER (LB) BOUNDARIES"
4110  PRINT "FOR EACH CATEGORY SUCH THAT LB <= X <= UB"
4120  PRINT "ENTER LOWER BOUNDARY FIRST, THEN UPPER"
4130  Jcat=1
4140  FOR J=1 TO M
4150   Jcat1=Jcat+1
4160    PRINT "CATEGORY ",J
4170     INPUT "LOWER BOUNDARY",Bounds(Jcat)
4180      INPUT "UPPER BOUNDARY",Bounds(Jcat1)
4190      CALL Switch(Bounds(Jcat),Bounds(Jcat1))
4200  PRINT "LOWER BOUNDARY IS ";Bounds(Jcat),"UPPER BOUNDARY IS ";Bounds(Jcat1)
4210      Jcat=Jcat+2
4220      NEXT J
4230  SUBEND
4240 !
4250 ! SORTING ROUTINE
4260 !
4270  SUB Sort(Number,Value,Bounds(*),Cat)
4280  Last=2*Number
4290  FOR J=2 TO Last STEP 2
4300   IF (Bounds(J-1)<=Value) AND (Value<=Bounds(J)) THEN 4340
4310    NEXT J
4320  Cat=Number+1       !only if Value is out of bounds
4330  SUBEXIT
4340  Cat=INT(J/2)
4350  SUBEND
4360 !
4370 !
4380  SUB Listcat(Isub,Num,Cat(*),Ind)        ! PRINT CODE AND CATEGORIES
4390 !
4400 !
4410  CALL Heading(Isub,Ind)         !PRINTS CODES
4420  I=1
4430  PRINT "  CATEGORY    LOWER BOUND    UPPER BOUND"
4440  FOR J=1 TO Num
4450   IMAGE 5X,2D,10X,3D.2D,9X,3D.2D,/
4460    PRINT USING 4450;J,Cat(I),Cat(I+1)
4470     I=I+2
4480      NEXT J
4490  PRINT
4500  SUBEND
4510 !
4520 !
4530  SUB Combine(Test,Pos1,Pos2,Pos3,Pos4,String$,D)  !COMBINE TEST SCORES
4540 !
4550  Test1$=String$[Pos1,Pos2]
4560  Test2$=String$[Pos3,Pos4]
4570  IF (Test1$[1,1]="/") OR (Test2$[1,1]="/") THEN 4610
4580  Test=(VAL(Test1$)+VAL(Test2$))/10
4590  D=1
4600  SUBEXIT
```

```
4610  D=2
4620  SUBEND
4630 !
4640 !
4650  SUB Convert(Code,Code$,Subj)        !CONVERTS DATA INTO REAL NUMBERS
4660 !
4670 !   INPUTS
4680 !        Code$  is a alphanumeric string
4690 !        Subj  is the index corresponding to subject
4700 !   OUTPUTS
4710 !        Code is numeric value of Code$
4720 !
4730 ! ******** WARNING *************
4740 !   SUBPROGRAM IS DATA SPECIFIC, NEW FORMATS OR DATA REQUIRE CHANGES.
4750  IF (Subj=1) OR (Subj=4) THEN 4810
4760  IF (Subj>=6) AND (Subj<=8) THEN 4810
4770  IF (Subj=10) OR (Subj=13) THEN 4810
4780  IF Subj=16 THEN 4810
4790  Code=VAL(Code$)/10
4800  SUBEXIT
4810  Code=VAL(Code$)
4820  SUBEND
4830 !
4840 !
4850  SUB Helper(Index)
4860 !
4870 ! THIS SUBROUTINE PRINTS THE DATA CODE FOR SUBJECT CORRESPONDING TO
4880 ! Index, PROVIDED THAT IT IS CODED DATA.
4890 !
4900 ! ************ WARNING *************
4910 ! THIS SUBPROGRAM IS DATA SPECIFIC, DIFFERENT DATA FILES, USING DIFFERENT
4920 ! FORMATS, WILL REQUIRE THAT THIS SUBPROGRAM BE CHANGED.
4930 ! ********************************
4940 !
4950  IF Index<>1 THEN 5010
4960  PRINT "     CODE          MEANING"
4970  PRINT "       1             HIT"
4980  PRINT "       0             MISS"
4990  PRINT
5000  SUBEXIT
5010  IF Index<>4 THEN 5090
5020  PRINT "     CODE           YEARS"
5030  PRINT "       1             <= .5"
5040  PRINT "       2            .5< X <= 1"
5050  PRINT "       3            1< X <= 3"
5060  PRINT "       4               >3"
5070  PRINT
5080  SUBEXIT
5090  IF Index<>6 THEN 5150
5100  PRINT "      CODE          VISUAL AID"
5110  PRINT "       0         NOT USED OR USE UNKNOWN"
5120  PRINT "       1             YES"
5130  PRINT
5140  SUBEXIT
5150  IF Index<>7 THEN 5220
5160  PRINT "      CODE          POSITION"
5170  PRINT "       1             PORT"
5180  PRINT "       2             STARBOARD"
5190  PRINT "       3            BRIDGE/HELM/PILOT"
5200  PRINT
5210  SUBEXIT
5220  IF Index<>10 THEN 5310
5230  PRINT "       CODE          TYPE"
5240  PRINT "         1         16' WHITE BOAT/ORANGE CANOPY RAFT"
5250  PRINT "         2         16' BLUE BOAT/ORANGE RAFT W/O CANOPY"
5260  PRINT "         3         BLACK RAFT"
```

```
5270  PRINT "          4         41' BOAT/RASBERRY RAFT"
5280  PRINT "          5         PIW"
5290  PRINT
5300  SUBEXIT
5310  IF Index<>13 THEN 5380
5320  PRINT "         CODE        HOURS"
5330  PRINT "           1          <4"
5340  PRINT "           2         4 - 6 "
5350  PRINT "           3          >6"
5360  PRINT
5370  SUBEXIT
5380  IF Index<>16 THEN SUBEXIT
5390  PRINT "         CODE       SEARCH UNIT TYPE"
5400  PRINT "           1          CUTTER"
5410  PRINT "           2          UTB"
5420  PRINT "           3          HELO"
5430  PRINT
5440  SUBEND
5450 !
5460 !
5470  SUB Switch(L,U)
5480  IF L<=U THEN SUBEXIT
5490  A=L
5500  L=U
5510  U=A
5520  SUBEND
5530 !
5540 !
5550  SUB Transfer(I,J,Cat(*))
5560  Iu=I*2
5570  Il=Iu-1
5580  Ju=J*2
5590  Jl=Ju-1
5600  Cat(Il)=Cat(Jl)
5610  Cat(Iu)=Cat(Ju)
5620  SUBEND
5630 !
5640 !
5650  SUB Heading(Isub,Ind)              !PRINTS TITLE
5660  COM Nsub,Labsub$(*)
5670  Which$="ROWS"
5680  IF Ind=1 THEN Which$="COLUMNS"
5690  IF Ind=2 THEN Which$="SCREENING"
5700  PRINT "SUBJECT FOR ";Which$;" IS ";Labsub$(Isub)
5710  CALL Helper(Isub)
5720  IF Ind<>2 THEN SUBEXIT
5730  PRINT "CATEGORIES FOR SCREENING FORM THE DATA BASE FOR ANALYSIS"
5740  SUBEND
5750 !
5760 !                   SCREENS THE DATA
5770 !
5780  SUB Screen(R$,Spos1,Spos2,Spos3,Spos4,L,Iscreen,Srncat(*),S)
5790 !
5800 !    RETURNS:    S = 0     IF EXCLUDED OR MISSING
5810 !                  = 1     IF INCLUDED AND REPEATS SHOULD BE SCREENED
5820 !                  = 2      "     "     "    "     " "    NOT BE SCREENED
5830 !
5840  COM Nsub,Labsub$(*),Pos(*),S$
5850 !
5860  S=1
5870  IF S$<>"Y" THEN SUBEXIT
5880  IF Spos1=Spos3 THEN 5920
5890  CALL Combine(Scode,Spos1,Spos2,Spos3,Spos4,R$,D)
5900  S=2
5910  ON D GOTO 5950,5970
5920  Srncode$=R$[Spos1,Spos2]
```

```
5930  IF Srncode$[1,1]=" " THEN 5970
5940  CALL Convert(Scode,Srncode$,Iscreen)
5950  CALL Sort(L,Scode,Srncat(*),Isrn)
5960  IF Isrn<=L THEN SUBEXIT
5970  S=0
5980  SUBEND
5990 !
6000 !
6010  SUB Sublist         !PRINTS A LIST OF SUBJECT AND INDEX
6020  COM Nsub,Labsub$(*)
6030  PRINT PAGE
6040  PRINT "  SUBJECT                   CODE"
6050  FOR I=1 TO Nsub
6060   PRINT USING "3X,20A,9X,2D";Labsub$(I),I
6070    NEXT I
6080  SUBEND
6090 !
6100 !
6110 !        REVIEW AND CHANGE SUBJECTS AND CATEGORIES
6120 !
6130  SUB Review(Ind,Isub,Num,Cat(*),Pos1,Pos2,Pos3,Pos4)
6140  COM Nsub,Labsub$(*),Pos(*),S$,S1$
6150 !
6160 !      FOR ROWS:        Ind = 0
6170 !          COLUMNS;    Ind = 1
6180 !          SCREENING;  Ind = 2
6190 !
6200 '      Isub = SUBJECT CODE, & index for Labsub$(*)
6210        Num = NUMBER OF BINS
6220 !      Cat(*) is array containing boundaries for bins
6230 !      Pos1,Pos2,Pos3,Pos4  are string positions for subject
6240 !
6250 !      Nsub is program parameter for maximun number of subjects.
6260 !      Labsub$(*) is array of subject labels for printing.
6270 !      Pos(*) is array of sting positions for data
6280 !      S$ and S1$ are answers to "DO YOU WANT TO SCREEN THE DATA?"
6290 !           asked at different points
6300 !
6310  PRINT PAGE
6320  IF Ind<>2 THEN 6380
6330  IF (S$<>"Y") AND (S1$<>"Y") THEN SUBEXIT
6340  IF (S$="Y") AND (S1$="Y") THEN 6380
6350  S$=S1$
6360  IF S1$<>"Y" THEN SUBEXIT
6370  GOTO 6430
6380  CALL Listcat(Isub,Num,Cat(*),Ind)
6390  INPUT "DO YOU WISH TO CHANGE ANY PARAMETERS?",A$
6400  IF A$<>"Y" THEN SUBEXIT
6410  INPUT "DO YOU WISH TO CHANGE THE SUBJECT?",A$
6420  IF A$<>"Y" THEN 6460
6430  CALL Sublist
6440  INPUT "ENTER NEW CODE",Isub
6450  IF (Isub<1) OR (Isub>Nsub) THEN 6440
6460  INPUT "DO YOU WISH TO CHANGE THE CATEGORIES",A$
6470  IF A$<>"Y" THEN SUBEXIT
6480  CALL Bound(Ind,Isub,Num,Cat(*),Pos1,Pos2,Pos3,Pos4)
6490  GOTO 6310
6500  SUBEND
6510 !
6520 !
6530  SUB Aswitch(Old(*),Col,Row,Orcat(*),Occat(*),Oexval,New(*),Ncol,Nrow,Nrcat
(*),Nccat(*),Nexval)
6540  Nexval=Oexval
6550  Ncol=Col
6560  Nrow=Row
6570  FOR I=1 TO Row
```

```
6580  FOR J=1 TO Col
6590  New(I,J)=Old(I,J)
6600  NEXT J
6610  NEXT I
6620  FOR I=1 TO Row+2
6630  Nrcat(I)=Orcat(I)
6640  NEXT I
6650  FOR J=1 TO Col+2
6660  Nccat(J)=Occat(J)
6670  NEXT J
6680  SUBEND
```

APPENDIX G

HUMAN FACTORS LOOKOUT DATA STORED ON TAPE #1

NAME	PRO	TYPE	REC/FILE	BYTES/REC	ADDRESS
T15		2			
1001		DATA	15	60	5
1002		DATA	14	60	9
1003		DATA	23	60	13
1004		DATA	19	60	19
1008		DATA	18	60	24
1009		DATA	15	60	29
1007		DATA	27	60	33
1005		DATA	59	60	40
1006		DATA	73	60	54
1010		DATA	31	60	72
1011		DATA	49	60	80
1012		DATA	109	60	92
1013		DATA	125	60	118
1015		DATA	20	60	148
1016		DATA	10	60	153
1014		DATA	21	60	156
1017		DATA	13	60	161
1018		DATA	125	60	166
1042		DATA	27	60	196
1019		DATA	105	60	426
1020		DATA	120	60	451
1021		DATA	110	60	480
1022		DATA	12	60	506
1023		DATA	27	60	509
1024		DATA	15	60	516
1025		DATA	26	60	520
1026		DATA	56	60	527
1027		DATA	13	60	541
1028		DATA	40	60	545
1029		DATA	43	60	555
1030		DATA	95	60	566
1031		DATA	34	60	589
1032		DATA	22	60	597
1033		DATA	18	60	603
1034		DATA	24	60	608
1035		DATA	7	60	614
1036		DATA	9	60	616
1037		DATA	34	60	619
1038		DATA	35	60	627
1039		DATA	21	60	636
1040		DATA	22	60	641
1041		DATA	20	60	647

FILES 1001-1015 CONTAIN THE WINTER 1981 CUTTER (W81CUT) DATA
FILES 1016-1024 CONTAIN THE FALL 1980 CUTTER (F80CUT) DATA
FILES 1025-1033 CONTAIN THE SPRING 1980 CUTTER (S80CUT) DATA
FILES 1034-1049 CONTAIN THE WINTER 1981 HELO (W81HEL) DATA

HUMAN FACTORS LOOKOUT DATA STORED ON TAPE #2

NAME	PRO	TYPE	REC/FILE	BYTES/REC	ADDRESS
T15		2			
1043		DATA	6	60	5
1044		DATA	6	60	7
1045		DATA	87	60	9
1046		DATA	25	60	30
1047		DATA	13	60	36
1048		DATA	49	60	40
1049		DATA	24	60	52
1050		DATA	14	60	58
1051		DATA	60	60	62
1052		DATA	105	60	77
1053		DATA	55	60	102
1054		DATA	17	60	115
1055		DATA	16	60	119
1056		DATA	46	60	123
1057		DATA	22	60	134
1058		DATA	16	60	140
1059		DATA	17	60	144
1060		DATA	18	60	148
1061		DATA	34	60	153
1062		DATA	37	60	161
1063		DATA	28	60	170
1064		DATA	17	60	177
1069		DATA	36	60	181
1070		DATA	11	60	190
1065		DATA	10	60	193
1066		DATA	8	60	196
1067		DATA	17	60	198
1071		DATA	12	60	202
1068		DATA	12	60	205
1072		DATA	30	60	208
1073		DATA	23	60	216
1074		DATA	11	60	222
1075		DATA	19	60	225
1076		DATA	34	60	230
1077		DATA	22	60	238
1078		DATA	39	60	244
1079		DATA	21	60	254
1080		DATA	8	60	259
1081		DATA	24	60	261
1082		DATA	48	60	267

FILES 1034-1049 CONTAIN THE WINTER 1981 HELO (W81HEL) DATA
FILES 1050-1055 CONTAIN THE FALL 1980 HELO (F80HEL) DATA
FILES 1056-1058 CONTAIN THE WINTER 1981 UTB (W81UTB) DATA
FILES 1059-1068 CONTAIN THE FALL 1980 UTB (F80UTB) DATA
FILES 1069-1072 CONTAIN THE SPRING 1980 HELO (S80HEL) DATA
FILES 1073-1082 CONTAIN THE SPRING 1980 UTB (S80UTB) DATA

HUMAN FACTORS LOOKOUT DATA STORED ON TAPE #3

NAME	PRO TYPE	REC/FILE	BYTES/REC	ADDRESS
T15	2			
F80CUT	DATA	550	60	5
W81CUT	DATA	980	60	134
S80CUT	DATA	340	60	364
W81HEL	DATA	390	60	444
F80HEL	DATA	255	60	536
S80HEL	DATA	85	60	596
W81UTB	DATA	85	60	616
F80UTB	DATA	180	60	636
S80UTB	DATA	230	60	679

HUMAN FACTORS LOOKOUT DATA STORED ON TAPE #4

NAME	PRO TYPE	REC/FILE	BYTES/REC	ADDRESS
T15	2			
CUTTER	DATA	1450	60	5
HELOS	DATA	750	60	345
UTBS	DATA	520	60	521

CUTTER CONTAINS W81CUT + F80CUT + S80CUT DATA COMBINED
HELOS CONTAINS W81HEL + F80HEL + S80HEL DATA COMBINED
UTBS CONTAINS W81UTB + F80UTB + S80UTB DATA COMBINED

HUMAN FACTORS LOOKOUT DATA STORED ON TAPE #5

NAME	PRO TYPE	REC/FILE	BYTES/REC	ADDRESS
T15	2			
SARWAR	DATA	2700	60	5

SARWAR CONTAINS CUTTER + HELOS + UTBS DATA COMBINED
THIS FILE CONTAINS ALL THE TOTAL COMBINED DATA FOE THIS PROJECT

HUMAN FACTORS LOOKOUT DATA STORED ON TAPE #6

NAME	PRO	TYPE	REC/FILE	BYTES/REC	ADDRESS
T15		2			
TEST3		DATA	155	8	5
TEST4		DATA	155	8	10
CSCUT1		DATA	90	8	15
CSCUT2		DATA	90	8	18
CSHEL1		DATA	35	8	21
CSHEL2		DATA	35	8	23
CSUTB1		DATA	35	8	25
CSUTB2		DATA	35	8	27

THESE FILES WERE CREATED BY THE CUMSCR PROGRAM AND THEN USED
WITH THE HEWLETT PACKARD GENERAL STATISTICS PROGRAM

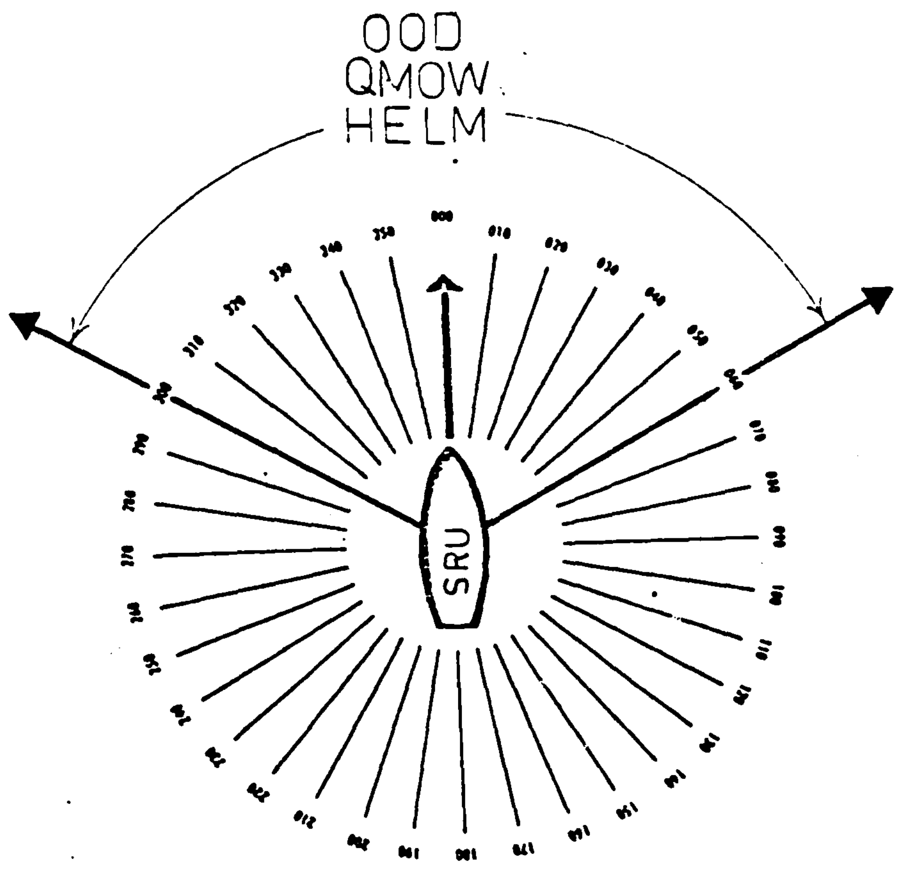
TEST3 CONTAINS HIDDEN FIGURES TEST SCORES FROM THE SARWAR FILE
TEST4 CONTAINS HIDDEN PATTERNS TEST SCORES FROM THE SARWAR FILE
CSCUT1 CONTAINS HIDDEN FIGURES TEST SCORES FROM THE CUTTER FILE
CSCUT2 CONTAINS HIDDEN PATTERNS TEST SCORES FROM THE CUTTER FILE
CSHEL1 CONTAINS HIDDEN FIGURES TEST SCORES FROM THE HELOS FILE
CSHEL2 CONTAINS HIDDEN PATTERNS TEST SCORES FROM THE HELOS FILE
CSUTB1 CONTAINS HIDDEN FIGURES TEST SCORES FROM THE UTBS FILE
CSUTB2 CONTAINS HIDDEN PATTERNS TEST SCORES FROM THE UTBS FILE

APPENDIX H

Templates depicting zones of responsibility for various lookout positions on cutters, Helos, and UTBs.

TEMPLATE USED TO DETERMINE ZONES OF RESPONSIBILITY FOR CUTTERS AND UTBS

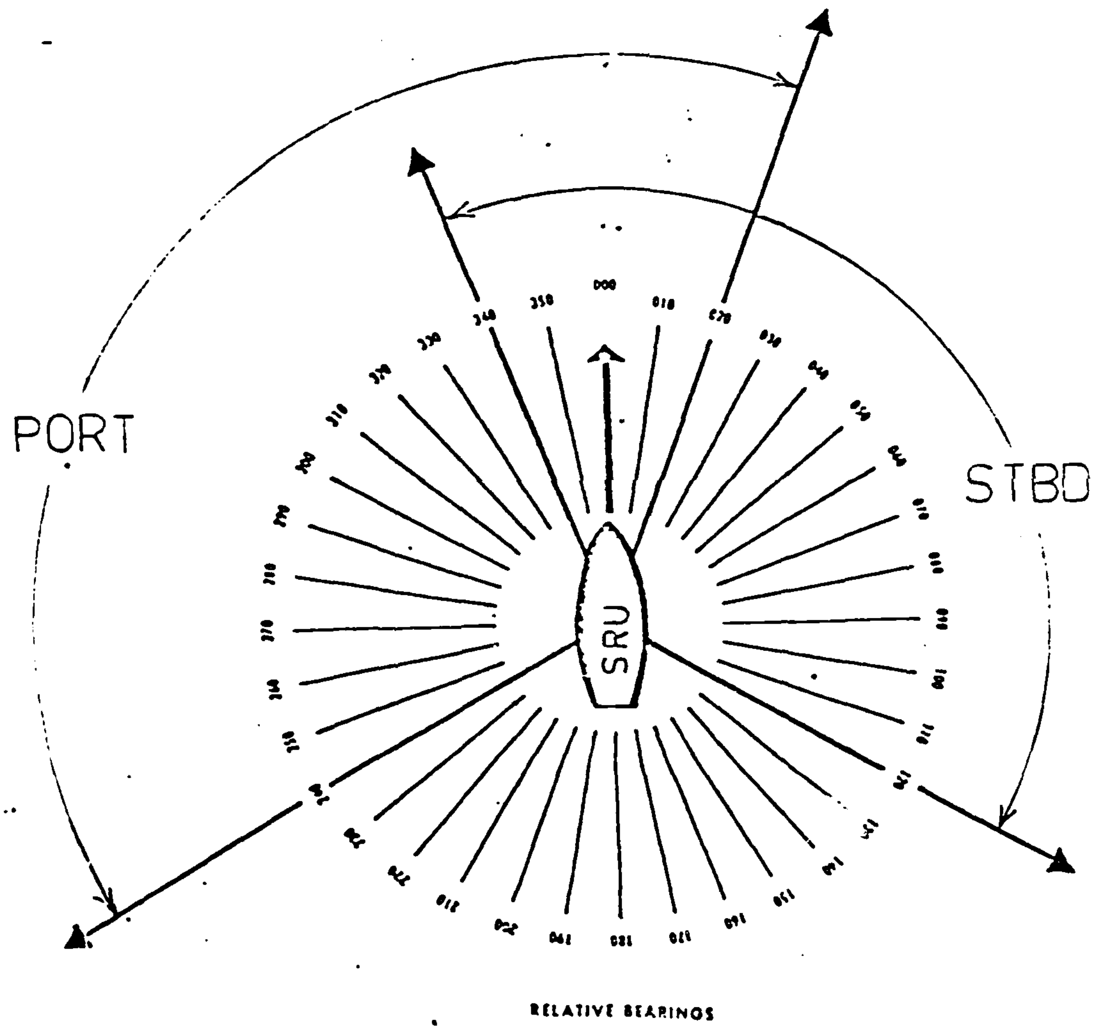
POSITION	AREA OF RESPONSIBILITY
HELM OOD QMOW	300-060



RELATIVE BEARINGS

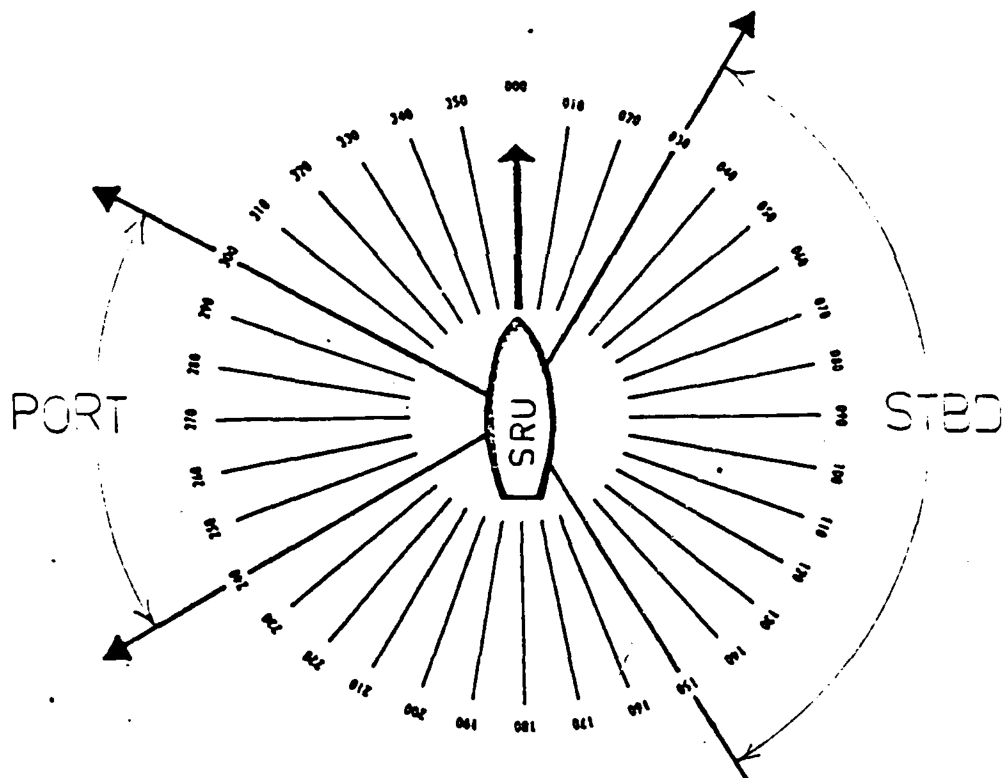
TEMPLATE USED TO DETERMINE ZONES OF RESPONSIBILITY FOR CUTTERS AND UTBS

POSITION	AREA OF RESPONSIBILITY
PORTSIDE LOOKOUT	240-020
STBD SIDE LOOKOUT	340-120



TEMPLATE USED TO DETERMINE ZONES OF RESPONSIBILITY FOR HELOS

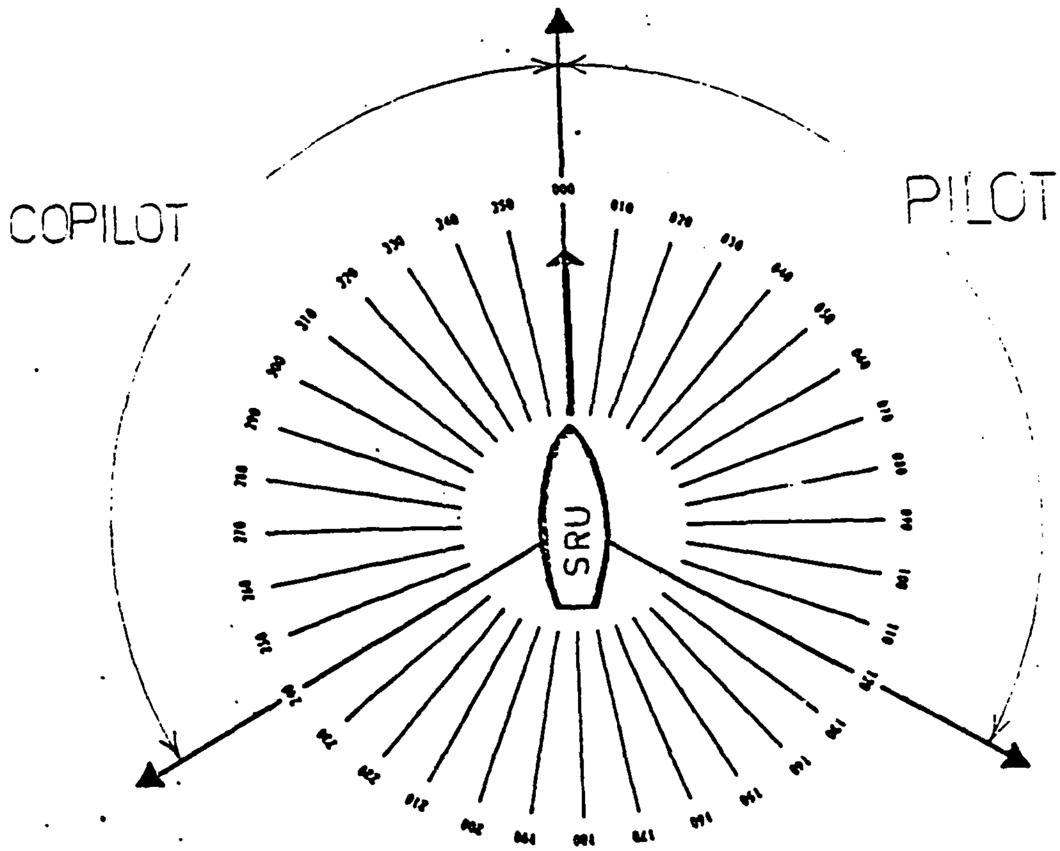
POSITION	AREA OF RESPONSIBILITY
PORT SCANNER	240-300
STBD SCANNER	030-150



RELATIVE BEARINGS

TEMPLATE USED TO DETERMINE ZONES OF RESONSIBILITY FOR HELOS

POSITION	AREA OF RESONSIBILITY
PILOT	000-120
COPILOT	240-000



RELATIVE BEARINGS

END

DATE FILMED

9-82

DTIC